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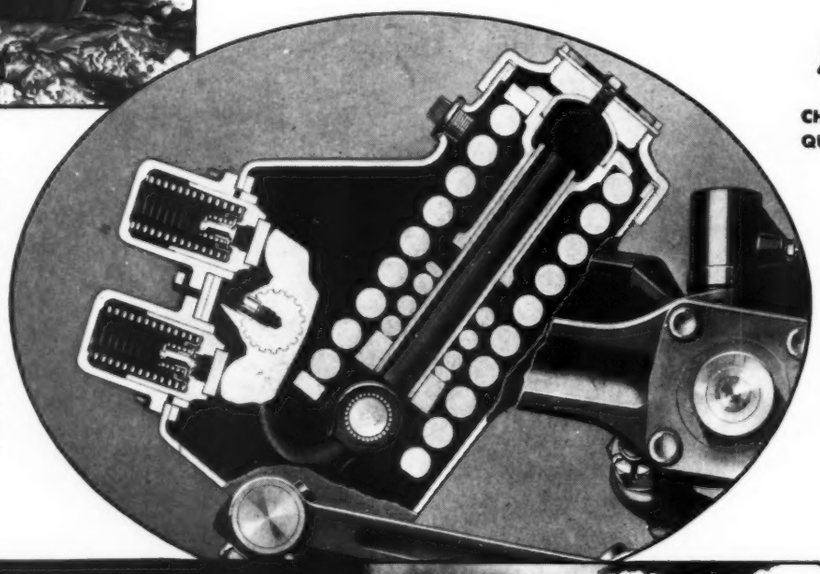

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MOTORISTS WISE

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Home-Repair Aids

FOR THE HANDY MAN

Using parts supplied in a handy kit, any home owner can transform his old-style garage doors into a modern upward-acting door like the one at the left. Levers and counterweights operate it. The original doors are seen in the picture below

SIMPLE KIT MODERNIZES DOUBLE GARAGE DOORS

ANY SET of old-style garage doors can be converted into a modern one-piece, upward-acting door by means of a kit of parts recently placed on the market. Consisting of levers, counterweights, pivot hinges, and slides, the hardware is easy to apply and requires a minimum of cutting, sawing, and chiseling. Installed, a clever balance lever counterbalances the door at all points, allowing it to be raised overhead, where it is out of the way, with fingertip pressure. Because they move up rather than out, doors of this type eliminate troublesome sticking during the winter months when ice forms on the driveway. Complete instructions are furnished.

PLUG-IN CEILING BOX FOR CHANDELIER

Chandeliers and other suspension lamps are installed or moved easily when fitted with this ceiling plug box. Plug prongs make the electrical connection, and the parts are held together by simple snap hooks

WITH a new type of ceiling box it is possible to alter the position of a chandelier or any other suspension lamp easily and quickly. Like an ordinary lamp plug and receptacle, the connection box is constructed in two parts; one being mounted on the ceiling and the other, known as the rosette, being fixed to the end of the hanging fixture. Easily operated snap hooks in the rosette hold the two parts together, and built-in plug prongs make the necessary electrical connections.

NEW FLOOR COVERING

LINOLEUM has been combined with insulating material to provide the home owner with a brand-new floor covering. The flooring, which is easily applied to either old or new floors, consists of sheet linoleum bonded to a chemically treated base which serves as insulation against both sound and cold. Sold in sheets ranging in size from one by eight feet to three by fourteen feet, this material, because of its flexibility and softness, is said to provide a springy and restful floor surface.

...a new Radio Miracle!

MAKING MUSIC COME OUT OF A GAS-PIPE! An early step in a two-year search for a practical and efficient metal radio tube—conducted in the General Electric "House of Magic." A search that made use of a newly created alloy, Fernico... that utilized an ingenious method of welding that applies 75,000 amperes, for one-twentieth of a second, to fuse two metals into one! Such research development, typical of the "House of Magic," alone made the new metal tube possible—marking a milestone in radio progress.

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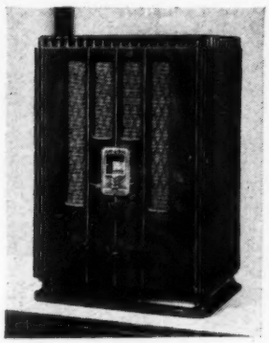
MODEL A-125—Twelve-tube superheterodyne, with five broadcasting bands. New metal tubes throughout. Neo-classic cabinet in walnut.



MODEL A-63—Six-tube superheterodyne, completely equipped with new metal tubes. Two reception bands. Distinctive cabinet of butt walnut veneer.

GE ELECTRIC RADIO

Our Readers Say

Veteran Jar Opener Spins a Sorrowful Yarn

FREQUENTLY I am summoned to the kitchen by a call, voiced in these words, "Oh dear! Will you take the cap off this jar for me?" When I get that call, I know I am licked before I start. The packers who placed the cap on that jar did so with a machine of fiendish design. That cap and all of its kind were destined to plague man when he should be in a tranquil mood to enjoy and to receive benefit from his daily bread. The odds are thousands to one that (1) you don't get the cap off without mutilating it, (2) you don't get the cap off without spilling some of the jar's contents on your trousers, or (3) you don't get the cap off without mutilating one or more fingers. Now why, in these days of scientific advancement, does not some one devise a cap that seals and can be removed with no ill effects by the meekest of husbands —or better still, by the wife? Such a benefactor should rate a statue in the Hall of Fame.—T.F., Boston, Mass.

Flowers Tame The Toughest of 'Em

IT TAKES a lot to make me want to write a letter to anyone. But here is what all this is about. I read an article in a recent issue telling how to keep flowers fresh. Being a natural skeptic, I decided to try the routine outlined with the belief, of course, that I would prove to my own satisfaction that the author had written a lot of bunk. But, by gad, it worked! We've just thrown out some cut flowers which kept fresh for eight days. Before we were lucky to keep them two days. And the best part of it all is my wife gives me credit for doing something, for once, about the house.—C. L., Rome, Ga.

Model Builder as Proud as Actual Builders of Normandie

THIS letter is sent to tell you how much I enjoyed building the simplified scale model of the *Normandie*. Just as soon as I got my copy of the magazine, I started to work, and actually had the model completed by the time the real *Normandie* arrived in New York on her maiden voyage. You deserve great credit for the timely interest of this feature; with the newspapers full of pictures and stories about the new liner, and everybody talking about her, I was very proud to be able to exhibit a model I had made with my own hands. I was among the hundreds of thousands of persons who watched the liner steam up New York Harbor, and I gladly paid my half dollar to inspect her while she lay at her pier. Needless to say, I felt that I knew every line and curve of that beautiful hull. I am sure that the real builder of the *Normandie* was no prouder than I.—J. J., Brooklyn, N. Y.

Advocates a Forum For P.S.M.'s Over-Seas Readers

AS A reader of POPULAR SCIENCE MONTHLY for several years, I have enjoyed Our Readers Say very much. Having noticed the number of foreign readers who contribute to this department, I have often wondered why your magazine could not have a Foreign Correspondence Column. Readers, many with common interests, could swap ideas, suggestions, etc., and have an international meeting place. I would also like to see articles on the steam auto and some plans for small rowboats.—H.R.H., New Hope, Pa.

Even Elements Change, Contends Evolutionist

THAT argument made by L.S.B., of Fullerton, Calif., against evolution is a lot of frog fur. He contends that because neither water nor any of the ninety-two elements have changed form, evolution is all wet. But the fact is that some of the elements are always changing, for instance, radium, uranium, and other radioactive metals. Further, how can he prove that water was H_2O a million years B.C., and not H_2O_2 or D_2O (heavy water)? And I'd like to hear him explain the remains of dinosaurs and pterodactyls. How about the Heidelberg man, the Java man, the Cro-Magnon man, and the bones of other primitive types that have been found? Scientists like Burbank have produced the results of evolution before our very eyes. They have created new species of plants and animals by processes of combination and elimination. This last fact alone, even though one knew little about the past history of life on this planet, should convert any disbeliever of evolution.—R. H., Edgewood, Pa.

Taking the Wrinkles Out of Self-Making Bed

EVIDENTLY K.R., of Long Island City., N. Y., isn't accustomed to making beds. If he were he would know that bedding has a tendency to adhere and hold together. This is particularly so in the case of woolen blankets. If his plan for a "self-making bed" were tried out, he would find that the bedding would not drop down unwrinkled from the frame. I can suggest an improvement to his original thought. Why not use a U-shaped frame for each piece of bedding? An individual frame for each piece would be much lighter than one for all the bedding and this arrangement would permit each piece to be raised separately and without the need of an overhead pulley and rope. When in a vertical position, each piece would hang flat and smooth in its respective place. The U-shaped frames could be attached to a standard bed frame by means of triangular blocks with pivotal mountings. In this manner, all the bedding could be lowered at one time without sliding or sticking. I think a "self-making bed" is a great idea.—C. H., Los Angeles, Calif.

Kangaroo Is Poor Substitute For Old Dobbin

WHILE conversing with a friend of mine who recently returned from Australia, the fact was brought out that the Australian continent has no native animal which can be used as a beast of burden. As this is the only continent where such a condition existed, I thought some of Our Readers Say enthusiasts might wish to search for a scientific explanation. At any rate, I was impressed with the fact that here was one place on our planet where the animals had played a unique trick on man.—L.K., Topeka, Kans.

Crossed Wires Gave Bulb Its Last Flicker

IN REPLY to R.J.R. of Sioux Falls, S. Dak., I believe I can tell him why the broken headlight bulb of his train appeared to function for a brief time. When the train was derailed and the bulb broken, the lamp wires became crossed, causing a complete circuit. When the current was again turned on, the contacting wires glowed with a white heat for a few seconds—until the ends were burned away, breaking the circuit—and this was the light he saw.—E.L.B., Beardstown, Ill.

Bring a Non-Skid Road Out of That Test Tube!

I AM one of that army of motorists who invade the highways over the week-ends. I have noticed with satisfaction the improvements that have been made on the main motor routes. Roads have been widened, intersections have been made safer, and better road markers have been installed —all of which contribute to safer and easier driving. Many of our motor accidents, however, occur during stormy weather — when roads are wet and cars skid. It seems to me that more research work should be carried on in connection with the road-building materials themselves. I do not believe it is beyond scientific attainment to obtain a skid-proof road surface. Or possibly the solution will be found jointly by the road builders and the tire manufacturers. In the meantime I will con-

tinue to drive carefully and wait for the coming of the Nemesis of skidding.—C.K., Hillside, N. J.

It Would Be a Great Show, If We Could See It

HERE is a thought—or is it? We see objects because of the light waves which they reflect and which are perceived by our brain through the medium of our eyes. These light waves continue to pass us and out into space. Are these waves dissipated or do they continue in this form ad infinitum? If the latter is the case, then there is an outward rushing panorama (somewhere in the universe) of life as it transpired on this planet since its very inception. In other words, we live and die but the record of our existence is preserved in perpetuity by these light waves. It is a fanciful thought to conceive of our images going on forever in the form of light waves and such reasoning borders on the point where science overlaps into the realm of metaphysics. While probably of no practical value, I pass my little brain storm along to you as some of your readers may wish to mull over the idea. —A.E., Ann Arbor, Mich.

When the Sun Did Not Rise On the British Flag

POSSIBLY you will find this yarn an interesting addition to the collection of "Strange Pranks of the Wind" published in a recent issue of POPULAR SCIENCE MONTHLY. In the island of Barbados, in the British West Indies, old-timers still talk about "the day the sun did not rise." That was a day in the year 1902 when a pale, yellow twilight covered the island from morning until night. This occurrence bewildered the inhabitants—especially the superstitious black people, who were sure that the end of the world was at hand. On the following day, when the sun apparently returned to his duty, it was discovered that a fine, powderlike dust had been deposited all over the island. The whole thing was explained by news of a volcanic eruption on the island of St. Vincent, nearly 100 miles to the westward. Fine volcanic ashes had been carried by the wind and dropped on Barbados, causing the bewildering haze. The strangest part of it was that the ashes had ridden an upper air current which moved in the opposite direction to the trade wind prevailing in this part of the world.—E.G., Miami, Fla.

They Can't Be Done— Is His Verdict

LOOKING over the letters from readers each month, I am reminded of the saying that history repeats itself—and usually about every generation. The problem of the tank, handed down from father to son, submitted by L.A.C., of Athol, Mass., is evidently intended to show a peculiar combination of dimensions which will produce a circular tank, the measurements of which are commensurable. But the ratios here are not commensurable. By a system of approximations, the upper diameter of the tank is found to be 42⅞ inches (only approximately correct). Also in the ditch-digging problem suggested by J.S., Rowland, N. C., the ratios given are wrong. The seventy-five cent man should receive 83 1/3 cents a foot.—E.E.B., Elmira Heights, N. Y.

Glass Gets the Blues Because Molecules Break Up

IN THE July issue, I was much interested in the query of Mrs. A.S., of San Simon, Ariz., asking why some of her glass bottles turned blue when exposed to the sun for long periods of time. Here is my answer. Certain varieties of electrical and light radiations, including the ultra-violet rays of sunlight, are capable of coloring glass, salts, and certain gems and minerals by ionizing small traces of impurities in them. The colors produced are attributed to the fact that the ions are unable to recombine in the solid and remain uniformly scattered through it. The bluish colors Mrs. A.S., describes is probably due to scattered ions of sodium or manganese in the glass. Only glass which contains certain impurities can be colored in this manner. If a sufficiently powerful stimulus, such as heat, is applied, the ions recombine into their normal molecules and the coloration disappears. Possibly, Mrs. A. S. may be able to restore her bottles to their normal color by such a method.—W.R.M., Honea Path, S. C.

Answers Cold Query But Topic Leaves Him Hot

FOR A long time I have intended to write a letter to Our Readers Say but I never seemed to have the time. You have an automobile accident to thank for this letter. I was injured and now have oodles of time. T.P.W., Minneapolis, Minn., wants to know how cold it is when the mercury has been at zero and the weather man says it is twice as cold on the following day. He or she thinks this will embarrass the readers but it is only a matter of physics. Whenever anything is said to be twice as cold, what is really meant is that it contains only half as much heat. So, using Kelvin's absolute scale, half of zero Centigrade is minus 136½ degrees C. No weather man, however, would state that it was twice as cold as zero because it never gets that cold on this planet. Such a temperature would register minus 260 4/5 degrees on the Fahrenheit scale. I think a girl wrote this letter, as the question impresses me as one coming from that sex.—J.E., Coeur d'Alene, Idaho.

Long Blade Makes Him Long For a Shave That Lasts

A SHORT article in a recent issue of your magazine about a razor that has a blade nearly five feet long interested me. The makers say it will give the average man six months of comfortable shaving. Now who ever heard of comfortable shaving or who believes that this daily drudgery afflicted upon the male can ever be made a comfort? I'll grow enthusiastic when some benefactor devises a method whereby one shave will give a man six months of real comfort—freedom from the daily shave!—N.B.F., New Haven, Conn.

Hobby Goes To Work In This Scheme

I HAVE in mind a business that can be started by many readers of POPULAR SCIENCE MONTHLY who love to experiment and who have accumulated some laboratory equipment. My idea is simply this: To open a store or other suitable quarters and give talks and demonstrations on the fundamentals of chemistry, physics, electricity, and other branches of science; to show their application to everyday mechanisms, such as, automobiles, refrigerators, vacuum cleaners, etc. Of course, it would be good business to introduce a few experiments of a spectacular nature—"magical tricks." The enterprise might be named, "Wonders of Science." Profit could be realized by charging a small admission fee or, indirectly, by selling laboratory supplies, books, and magazines. Not only would such an enterprise offer a opportunity for profit but it would enable one, I think, to do something worth while.—F.C., Brooklyn, N. Y.

She Suggests a Guild Of Home-Workshop Wives

ISN'T it about time we wives of home-workshop enthusiasts organized for mutual aid and protection? I am sure that we have a lot of problems in common, and we ought to be able to give one another valuable advice. For example, I wonder what my sisters in suffering do about the junk that accumulates in the basement shop. My husband would as soon part with his right hand as with any odd piece of metal, rubber, or wire that he gets hold of. The result is that our cellar looks like a glorified junk yard. Sometimes, in desperation, I timidly suggest throwing a lot of the stuff away; he good-naturedly agrees, but when it actually comes to the point of parting with one of his treasures, he always shakes his head and says, "Well, you never can tell when it may come in handy." And I must admit, it sometimes is surprising how those odd pieces of junk will turn up in unexpected places. What's *your* solution, fellow home-workshop wives?—Mrs. E.K., Harrisburg, Pa.

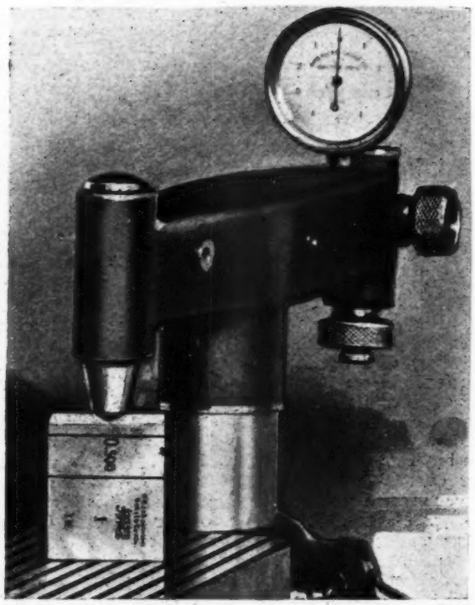
Maybe the Next Step Will Be A Pair To Match Each Suit

HAS E.E., of Chicago, Ill. who wants rain protectors for his pants ever heard of "leg-brellas"—one for each leg? They can be made of a lightweight rubber which is cut and fashioned to fit the wearer. One of these rain guards is worn outside each trouser leg and is suspended in position by a strip of elastic fastened to a clip on the belt. Each guard covers the trouser leg from above the knee to the bottom of the trouser cuff. When not in use they can be folded compactly and be carried conveniently in a coat pocket. These serviceable protectors can be made with a very small outlay of time and money. Who enjoys sitting for hours with trouser legs rain-soaked from the knees down? I don't.—W.E.B., Pewaukee, Wis.

A Flag To Make Armies Disappear

A RECENT issue of your magazine carried an article about a flag adopted (and endorsed by the League of Nations) to mark art and scientific centers in time of war. These flags are for international distribution and their display would protect all buildings flying them from war-time attack. This is a step forward but some day I hope I can pick up my POPULAR SCIENCE MONTHLY and read of another flag that has been adopted. This flag would signify that the occupants of the dwelling or building flying it were not in sympathy with the war activities in progress and, as such, were immune from attack. I do not believe that many people would fail to fly such a flag. That would be a real Flag Day and a permanent insurance against war and jingoistic speeches.—T.C.M., Middletown, Ohio.

Measurements *300 times* finer than a human hair

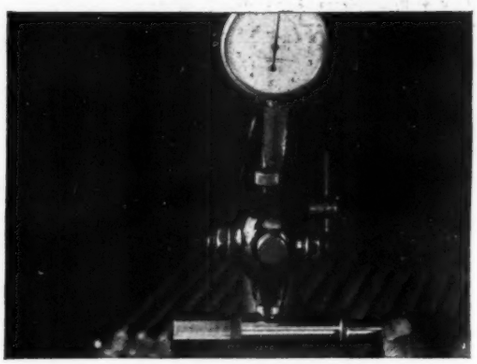


This shows how the accuracy of an Amplifier Gage is checked with Johansson Gage Blocks.

EVEN though automobile parts are produced by highly developed methods on special machines, there is only one way to insure their accuracy. That is by careful inspection.

For the inspection of Ford parts many of the gages used are of the amplifying type with each graduation on the dial indicating one ten-thousandth part of an inch. The precision of the parts can be no greater than the accuracy of the gages used to inspect them. Because of this all Ford inspection gages are checked by Johansson Gage Blocks—the world's standard of measurement and the most accurate system known.

These gage blocks are accurate within a few millionths of an inch. It is possible to measure with them in hundred thousandths of an inch—that's approximately 300 times finer than a human hair. They are manufactured by the Johansson Division of the Ford Motor Company and are used by scientific laboratories and all industries where precision is a requisite.



An Amplifier Gage being used to inspect Water-pump Shafts.

Many of the tolerances now held on Ford parts were considered impossible for large production until just a few years ago. At that time limits of one-thousandth of an inch were considered close. Many Ford limits have been cut to one-tenth of this. Piston pins and piston-pin holes are but two examples where tolerance is within one ten-thousandth of an inch.

Holding to such close tolerances increases costs because all machines and tools must be kept in first-class condition to produce parts that will pass the rigid Ford inspections. In spite of this, the price you pay for Genuine Ford Parts is consistently low.

Special Amplifier Gages are used to inspect Connecting-rod Bearings.

There is only one standard of limits established for Ford parts regardless of whether they are for production or for replacement. That's why you can depend on Genuine Ford Parts to fit as accurately and function as efficiently as the original parts.

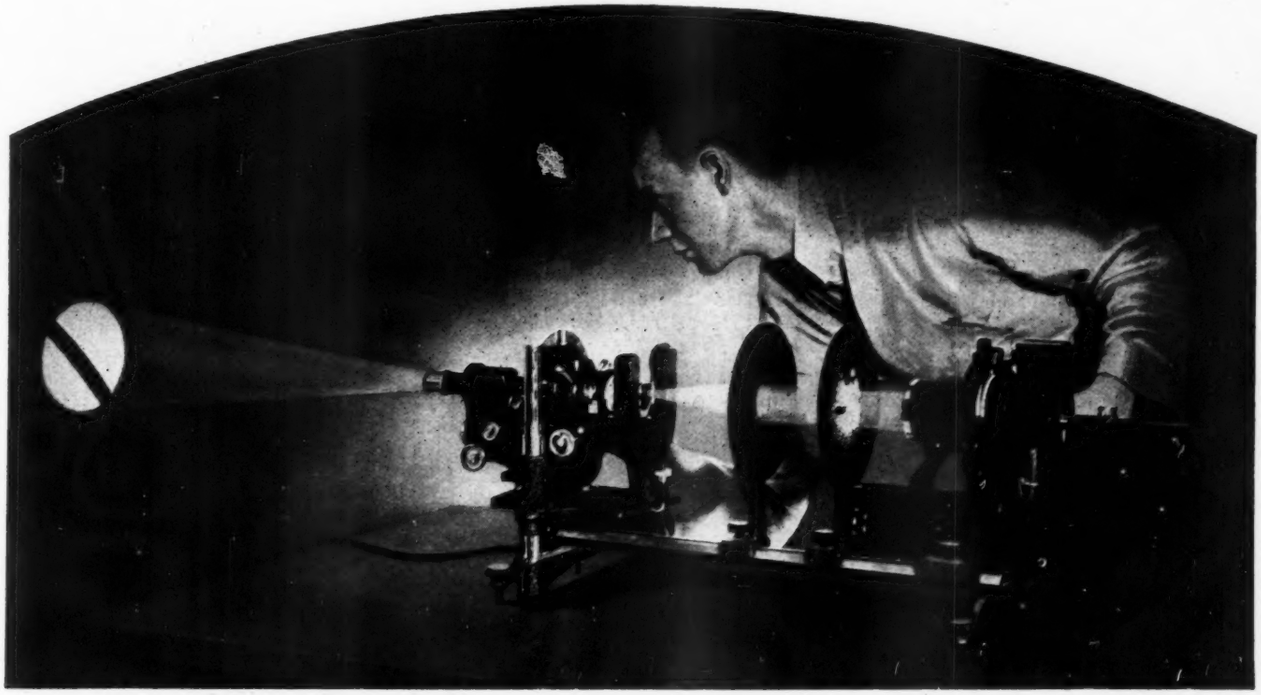
GENUINE Ford PARTS

FORD MOTOR COMPANY • DEARBORN, MICHIGAN

POPULAR SCIENCE Monthly

SEPTEMBER 1935 VOL. 127 No. 3

RAYMOND J. BROWN, Editor



Aided by a micro-projector, Uncle Sam's scientific detectives study enlarged images of hairs and fibers in their hunt for clews

GREATEST

Crime-Detection Laboratory

AIDS IN NATION-WIDE MAN HUNTS

ACROSS a vast checkerboard of farms and forests, G-men in the Northwest were moving swiftly. They were zigzagging by plane and auto to corner the kidnapers of nine-year-old George Weyerhaeuser.

Developments followed one another in rapid-fire order. The kidnap car was found. Part of the ransom was uncovered. Two of the criminals were captured. The smooth-working Department of Justice machine again was sweeping into action.

This dramatic chase was at its height when I spent a day in the gray stone building that houses the throttle room of the vast machine. Here, 3,000 miles from the scene of the crime, J. Edgar Hoover and his aids were directing the pursuit. And, behind them, ready for instant use, stood the most elaborate scientific crime-detection laboratory ever established.

With the fingerprint section, it covers 70,000 square feet—one whole floor of the new $9,000,000 Department of Justice Building, in Washington, D. C. It forms a striking monument to the advancement of scientific crime detection in recent years.

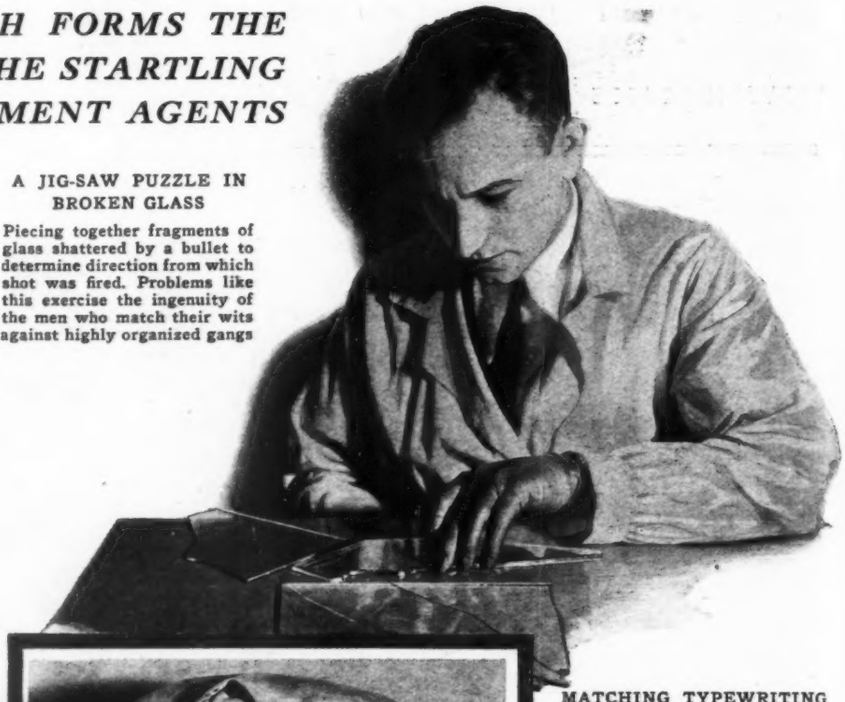
As you move from room to room, you see arcs that give off parallel beams, lamps that produce black light, chemicals of a hundred kinds, X-ray tubes, moulage molding outfits, delicate balances, dozens of microscopes, special cameras, devices for studying bullets, hairs, fibers, and handwriting. There are even live rabbits that produce the serum used in testing stains for blood.

Evidence from as far away as the Pacific Coast is rushed by mail plane to the laboratory and the report is telegraphed back to the G-man in the field. Six hundred of these crack detectives are scattered from coast to coast. Tagged pins on a huge map in Hoover's office show their location. In groups, they are coming to Washington for scientific training.

By

EDWIN TEALE

PATIENT RESEARCH FORMS THE BACKGROUND OF THE STARTLING FEATS OF GOVERNMENT AGENTS



A JIG-SAW PUZZLE IN BROKEN GLASS

Piecing together fragments of glass shattered by a bullet to determine direction from which shot was fired. Problems like this exercise the ingenuity of the men who match their wits against highly organized gangs

All examination work, at present, however, is done by the experts of the central laboratory. Two hundred and fifty cases a month, an average of almost ten a day, come in for them to study and solve.

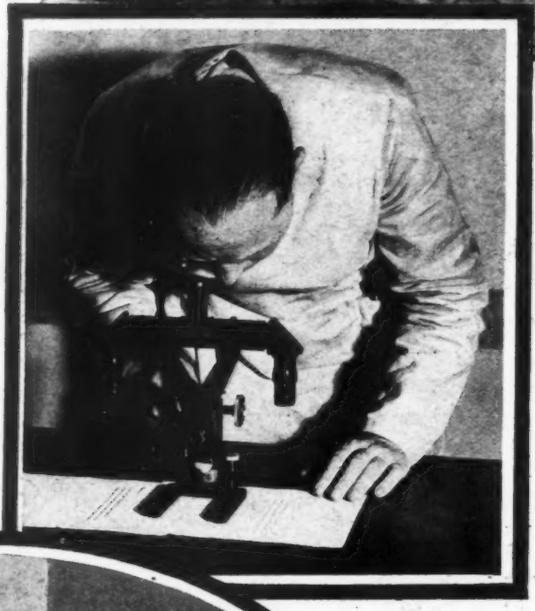
Take a comparatively recent one. It illustrates the variety of the work and the infinite care with which these experts search for hidden clews.

Late one morning, a postman at Coatesville, Pa., delivered a package to the U. S. Veterans' Hospital. It was wrapped in brown paper, postmarked Philadelphia, and addressed, by means of a typed sticker, to Harrington Fitzgerald, Jr., one of the patients at the hospital. Fitzgerald opened the package and found inside a tin box holding a pound of homemade chocolate fudge. A card in an envelope contained the typed words: "From Bertha."

Wondering who Bertha was, Fitzgerald munched a piece of the candy. Soon afterwards, he became violently ill. Examination showed the fudge was dosed with arsenic. As the attempted murder occurred in a Federal hospital, G-men took up the trail of the sender of the package. As a source of clews there was only the candy, the card and envelope, the tin box, the brown wrapping paper, and the typed sticker.

What followed is a classic of scientific sleuthing. The materials were forwarded to the Washington laboratory. There the scientific magic began. With black light, microscopes, scales, gauges and chemicals, the experts studied, weighed, and measured the paper. They noted the watermark; examined the fibers; recorded every telltale peculiarity of the card and its envelope. In the end, they traced it to a certain jewelry store 200 miles from Philadelphia, at Troy, N. Y.

Among the patrons of this store was a relative of Fitzgerald's. A second clew pointed to the same suspect. Tests showed the address on the sticker had been written on a certain model of a well-known make of typewriter. In a Troy repair shop, a Department of Justice man found just such a typewriter. It had been left by the suspected woman for adjustment. Samples of its typing were forwarded to Washington. They tallied exactly with that on the sticker.



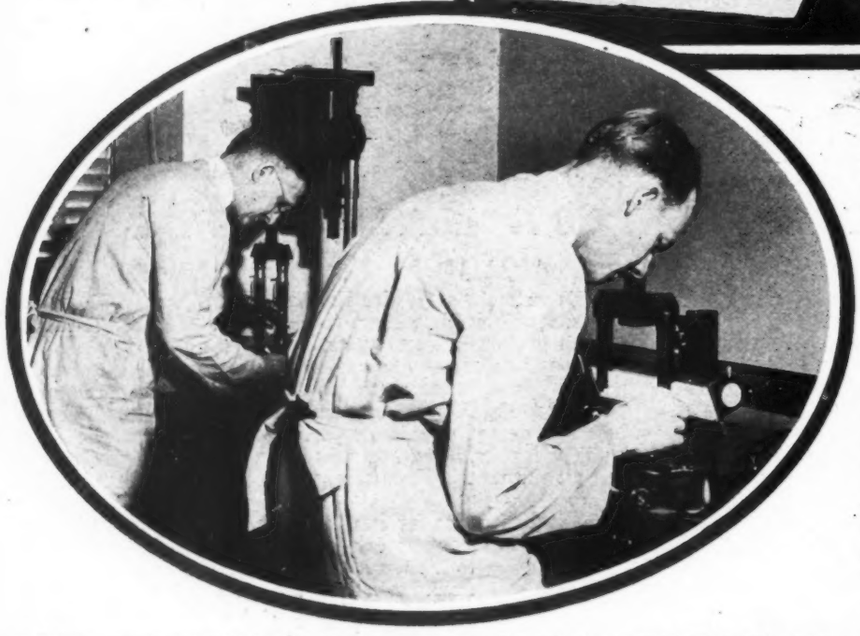
MATCHING TYPEWRITING ON KIDNAP NOTES

With the synchrisiscope, an instrument recently introduced at the laboratory, it is possible to compare handwriting, typing, or printing on extortion messages

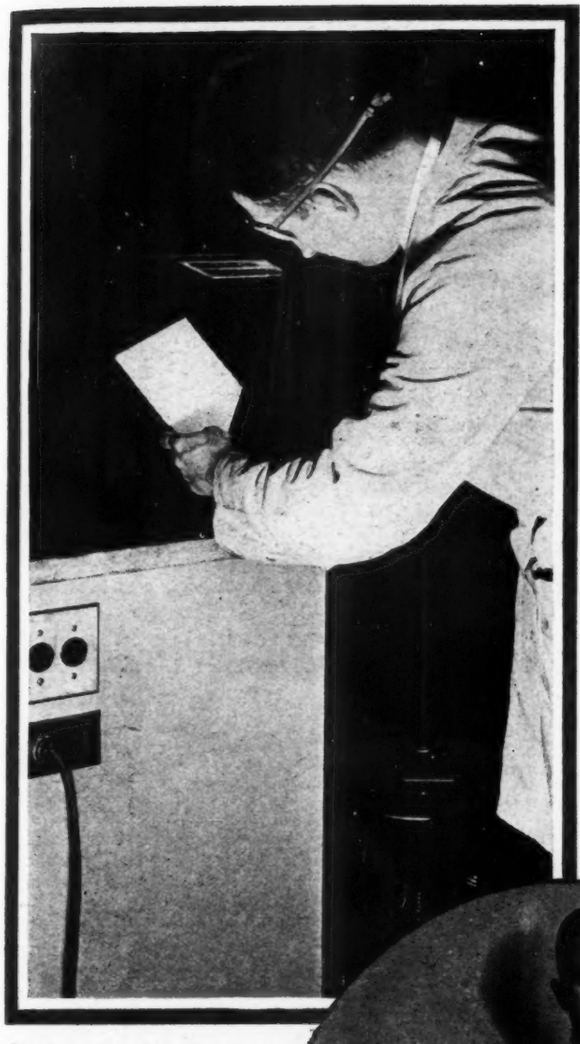
But this was not all. Scientific tests made on the tin box resulted in tracing it to a Troy store where the woman traded. Thus, with only tin and paper and typing to aid them, the Washington sleuths had tracked down the would-be murderess. The case ended with her commitment to the insane asylum.

As an aid to their work in identifying paper, the G-men have collected 28,000 watermarks. They all are neatly filed on indexed cards. Samples of typewriting from every known American machine are also filed on three- by five-inch cards. Binocular microscopes that give a three-dimensional effect aid in studying typing. In addition, a new instrument, known as a synchrisiscope, has been imported from abroad to help compare handwriting and printing. A variation of the comparison microscope, it saves precious time in studying evidence submitted from the field.

Recently, an ingenious attempt was made to outwit the laboratory scientists. An extortioner typed his threatening letter first in lower-case letters and then, on top



Ballistics experts using high-powered microscopes to study and photograph bullets and shells. Bullets fired from guns of suspects are compared with those which have figured in actual crimes



BLACK LIGHT DISCLOSES SECRETS IN PAPER

A large ultra-violet-light machine being used to examine a ransom note. The invisible rays cause many substances to glow, and often reveal hidden writing or telltale clews

of these, retyped it in capitals, thinking this would make tracing the typewriter more difficult. Curiously enough, the ruse made the work of the G-men easier instead of harder. It gave them twice as many letters to work on.

Another attempt to "beat the lab" is producing a new file at the Washington headquarters. It will hold specimens of the type used in different American newspapers. A kidnap note was formed of words clipped from newspapers. The gang that sent it thought this would make tracing it back to the sender impossible. But Department of Justice men have more than one string to their bows. Fingerprints and other evidence tripped up the crooks. However, the alert G-men are not missing a bet in their battle with crime. Immediately, they began laying the groundwork for a complete file of the type used in all American newspapers.

Photostats of more than 700 extortion, threat, poison-pen, and kidnap letters have been assembled and indexed. An attempt to classify handwriting, as fingerprints are classified, is under way. Unexpected disclosures, I was told, have been a by-product of this file. In going over the cards, the men have noticed the same handwriting appearing over and over again. When they pinned one of these notes to a sender, they cleared up a score of other crimes.

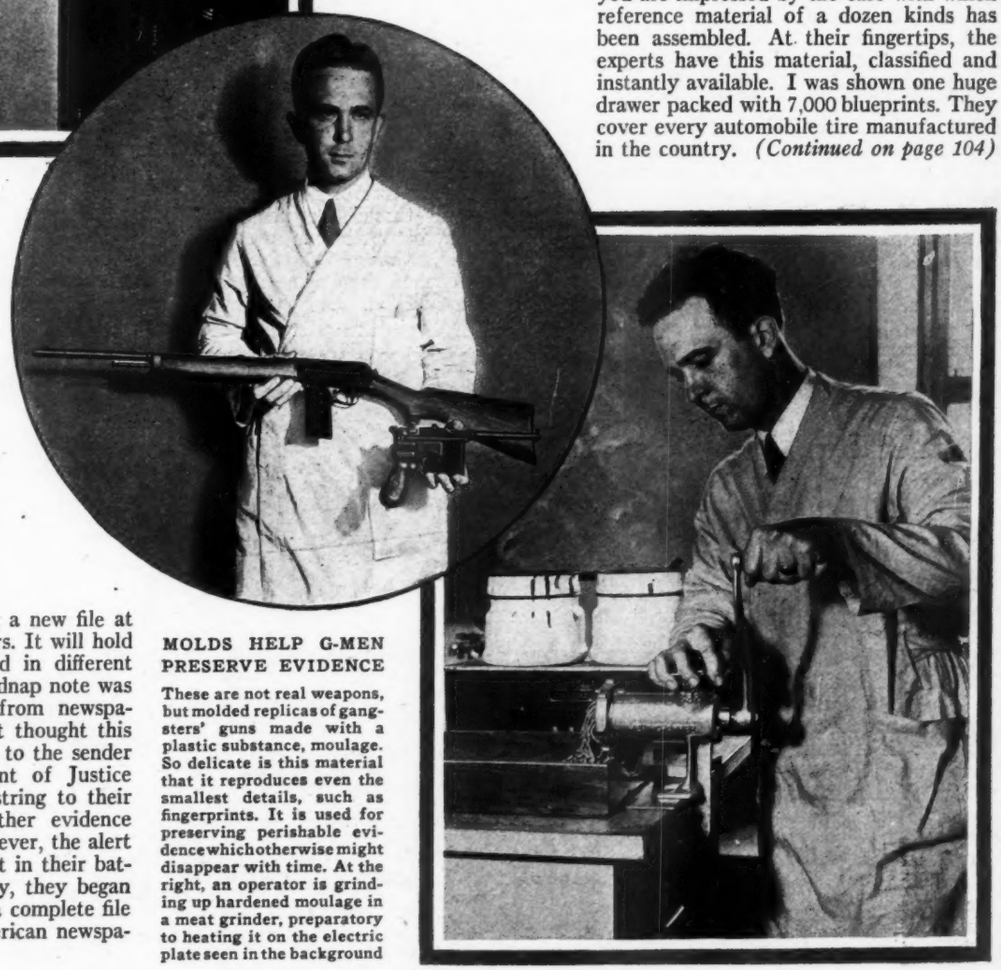
A typical case is the "Who's Who" extortioner who operated from New York City.

Early last spring, a woman in Bridgeport, Conn., received a letter which demanded $12,500 and threatened serious injury if she failed to comply or notified the police. The letter was forwarded to the Federal laboratory and studied by experts. They found the same handwriting on other letters which had been sent to famous people in various parts of the country. Tracing back by clever detective work, G-men pinned the crimes on a New York suspect, Peter Smindak. In his home, the agents discovered a card-index system which contained the names of 150 prominent people to whom he had written or intended to write extortion letters. Beside the file was a well-thumbed copy of "Who's Who in America," from which he had obtained the names and addresses.

Even more extensive were the operations of another New York crook, trapped by Federal sleuths. He had sent out 250 threatening letters, picking the names from the New York City telephone directory. On the notes, he sprinkled red nail polish or iodine to simulate blood and frighten his victims. The letters were signed "Gangsters" and the money was to be left in places ranging from a certain seat in a Broadway theater to a hole behind a rock in the Bronx Botanical Gardens. Fingerprints, handwriting, and paper analysis gave the scientific detectives clews that sent this extortioner away for a long term in the penitentiary.

In their study of notes and letters, the laboratory men have another tool at their command. Playing a concentrated beam of light across the paper, parallel to its surface, they search for indented writing left when a pen or pencil was pressed on the preceding sheet of the tablet. Such "ghost letters" often provide valuable clews.

As soon as you enter the laboratory, you are impressed by the care with which reference material of a dozen kinds has been assembled. At their fingertips, the experts have this material, classified and instantly available. I was shown one huge drawer packed with 7,000 blueprints. They cover every automobile tire manufactured in the country. *(Continued on page 104)*



MOLDS HELP G-MEN PRESERVE EVIDENCE

These are not real weapons, but molded replicas of gangsters' guns made with a plastic substance, moulage. So delicate is this material that it reproduces even the smallest details, such as fingerprints. It is used for preserving perishable evidence which otherwise might disappear with time. At the right, an operator is grinding up hardened moulage in a meat grinder, preparatory to heating it on the electric plate seen in the background

Amateur Pilot SETS RECORD OF 2,000 Daily Flights

Dr. John D. Brock's three private airplanes in flight over the airport at Kansas City, Mo. The owner is leading the formation in a cabin biplane

Rain or Shine, This Aviation Enthusiast Has Taken A Plane into the Air Every Day For Nearly Six Years

By ANDREW R. BOONE

EVERY DAY for nearly six years, Dr. John D. Brock, of Kansas City, Mo., has lifted one of his three airplanes from a runway somewhere in the United States or Canada for a flight. On some days, he has remained in the air for as little as ten seconds; at other times, he has flown eighteen hours out of the twenty-four. In sunshine, driving rain, pelting snow, or blinding storm, he has gone aloft for at least a brief hop on more than 2,000 consecutive days.

No other man in aviation has approached such a record. Miles and hours flown by this remarkable aviation enthusiast are the equivalent of twenty-five flights around the world. His transport-pilot's license, No. 105, antedates more than nine tenths of all yet issued. And, not one accident mars the perfect record written in his "country-style" log book.

The story of this middle-aged manufacturer's amazing attempt to prove that any one can fly anywhere in the United States at some hour every day, properly begins on November 29, 1929. He was standing with a group in a hangar on old Richards Field, in Kansas City, when somebody complained about the weather. The day was gray, with a drizzling rain. Wisps of fog and low-lying clouds moved unhurriedly across the countryside. "Unfit for flying," was the opinion of other pilots.

By way of answering the complaints, Dr. Brock rolled his two-place, open-cockpit ship out onto the warming-up platform, called "contact!" to a mechanic, and, a few minutes later, disappeared down the runway into the storm.

When I visited Kansas City, the other day, to learn for the readers of POPULAR SCIENCE MONTHLY the secret of this man's unusual record—why he has continued through summer and winter this inflexible routine, and what he considers necessary to increase the interest of men and women everywhere in aviation—I found him at the airport pondering the weather before hopping off on his daily jaunt.

This time, again, rain was falling. Clouds obscured visibility beyond the first mile or so. Airliners were carrying no passengers. Yet he continued his preparations for the flight, and, soon after reaching the field, I found myself sitting beside him, bouncing up the field to the head of the runway. There we stopped. Brock kicked left rudder, turned the ship across the take-off strip, and gunned the engine. He adjusted the radiophones to his ears, looked carefully up and down the field, and turned the plane south. Making sure that both our safety belts were fastened, he reached for the throttle. Slowly he opened the engine, and in a trice we were rolling. Our tail came up, the wheels sloshed through two puddles of water, the nose rose, and after a short run we were in the air—on Brock's 2,020th daily flight.

Twenty minutes later, we landed on the soggy field and taxied up to the hangar. There Brock handed me his log book, a loose-leaf arrangement of individual reports. I signed my name, certifying to the flight, a hop which brought his number of hours in the air to the astonishing total of 5,137. In this book are many famous names, including those of Herbert Hoover and Admiral Byrd; some of the reports are signed by men and women who, like myself, soared aloft in one of

With radio earphones adjusted, America's most active amateur pilot shoves the throttle forward and takes off for a flight in the rain. He follows radio beams when flying in heavy weather

At the call of "Contact!" a mechanic spins the propeller of Brock's cabin biplane as the sportsman-pilot prepares to make his daily flight

these record-breaking airplanes, others by ground observers who merely watched Brock make his daily flight.

Although the pilot started his long and unbroken series as an answer to a challenge, he does not look upon it merely as a stunt. During the twelve months preceding the start, he had missed only eleven days in the air. Since commencing the present string of aerial jaunts, he has placed himself and his ships at the disposal of many organizations sponsoring aviation developments.

For instance, Brock conceived the idea of spreading Kansas City's fame over the continent by visiting all prominent cities. A few weeks later, with Col. Ruby D Garnett as his passenger, he hopped off. Within a month the flying ambassadors dropped down onto 200 airports in the United States and Canada, called on the governor of every state in the Union, and met each committee according to arrangements made weeks earlier, with no mishap anywhere along the line.

No accidents befell him, but before Brock finished that 25,000-mile tour he skirmished with death more than once. He walked onto the field at Montpelier, Vt., one morning, ready for the 200-mile hop to Portland, Me., where a large meeting awaited him. Low clouds and heavy mist had grounded the airliners, but the aerial voyager wanted to keep his record unblemished, so he took off.

Fifty miles out of Montpelier, Brock ran into weather so thick he could see only a few hundred feet ahead. He swung the ship around to survey the mountains over which he already had flown, only to see the ridges disappearing in clouds.

"Tight place," he commented, in telling me of the incident, "but I had small choice as to what I should do. Fortunately, I had blind-flying instruments, so I eased back on the wheel and started climbing. Those clouds must have been about a half mile thick. When I got on top, I set a compass course for Portland. I knew when I left Montpelier that Portland had a clear ceiling of 1,500 feet, so I checked my time and flew an hour and twenty minutes, then stuck her nose down. I watched my altimeter carefully, just to measure the clouds, and, after gliding down 2,000 feet, I could see the city in the distance, while the airport was in sight off my left wing."

The author signs Brock's log book, certifying the 2,020th consecutive daily flight. At the left is shown the page containing the record. Each flight is attested by a passenger or by an observer on the ground

Brock followed well-marked and well-lighted air lanes during the tour, until he reached Washington, D. C. From that point, being tired and anxious to return home, he chose a direct route—with almost disastrous results. Over Kentucky, heavy rain beat against his wings with such force as to drive him down to within a few feet of the treetops. Landmarks became obscured. Once he found himself over a railroad, and checked his position by skimming over a station to read the town's name on the signboard.

So hard did the rain drive, that he could not rise more than fifty feet above the earth. He flew several miles below the level of the tops of trees lining the Kentucky river, able to see only one bank through the downpour. For thirty miles he followed the river, then managed to stagger over the trees and drop his ship into a sodden pasture. The rain was falling so hard that a curious boy stood twenty minutes in the door of a near-by house before venturing out to the plane.

"Where are we?," Brock asked, when the youth approached.

"Mile and a half east of Crab Orchard."

"Ever hear of a Brock farm in this neighborhood?," the aviator inquired.

"Sure," the boy told him. "You're on it."

After flying a distance equal to a round trip between the north and south poles on the good will tour, Brock was driven to earth on his family homestead!

Two of the toughest flights of which I have heard carried Brock aloft under conditions that few professional flying dare-devils would willingly face. One winter morning, the aviator drove out to Fairfax Airport, in Kansas City, only to find an eighteen-inch blanket of fluffy snow covering the runway. But he rolled a ship out and, much to the astonishment of watchers, started her rolling across the snow.

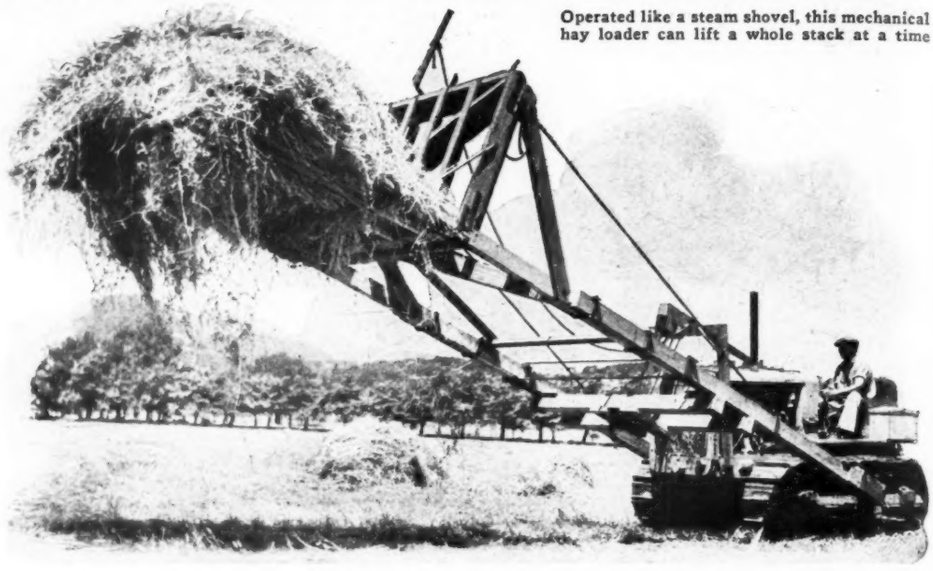
"It was hard to get any speed," he relates, "but, by gunning the engine and yanking the stick back, I rolled her up on top like a speed boat on its step. Slowly the wings caught, lifting the wheels an inch at a time. Believe it or not, I got off in 150 feet. The ship was light. I had only a few gallons of gas. That helped."

Then, there was the breath-taking flight Brock made in a blinding snow. He wanted to continue his daily flights, and since the weather showed no signs of improving, he decided to risk a hop. He taxied to the southeast corner of the airport, his plane disappearing from the view of a half dozen watchers huddled beside the hangar before it reached the head of the runway. But they heard his engine as he gunned it to turn into the wind, and heard its steady roar as he flew, invisible, across the field. Ten seconds after leaving the runway, he was down again. Since no one actually saw him, later that day he made a second flight, which was duly attested.

Brock places *(Continued on page 98)*

MECHANICAL PITCHFORK SPEEDS WORK OF LOADING HAY

RESEMBLING a gigantic pitchfork, a mechanical hay loader designed by three California inventors makes short work of filling a farm wagon to capacity. The labor-saving device is mounted on a tractor for speedy maneuverability, and power to run it is supplied by the tractor engine. One man can handle the machine. By manipulating levers after the manner of a steam-shovel operator, he can lower the big wooden boom to scoop up a stack of hay and raise it to the top of the wagon, where the load is ejected. The inventors claim that the new machine will revolutionize the harvesting of hay, especially on large ranches where the great extent of grass lands makes hand loading excessively slow and expensive. In the photograph, one of the inventors is demonstrating it.



Operated like a steam shovel, this mechanical hay loader can lift a whole stack at a time

GREASED PLATFORM AIDS LIFE GUARDS

TO AID life guards in rescuing swimmers in distress, a new attachment for a boat consists of a curved, greased platform at the stern, over which the bather may easily be hauled aboard. The rescue platform is made of enameled wood and may readily be attached or detached by means of a pair of screw clamps. Its use is said to make rescues more speedy, and to minimize risk of injury to the person saved.

Life guards demonstrating a new boat attachment which makes it easy to drag a rescued person aboard

FLASH LIGHT OPERATES VAPORIZER AND INHALER

ATTACHED to an ordinary flash light, a new vaporizer and inhaler is declared to bring relief to sufferers from hay fever, colds, and other ailments. The attachment provides a chamber in which a medicinal preparation is vaporized by the heat of a special flash-light bulb, and a nose piece facilitates inhaling the fumes, as shown above. Operating the flash-light switch turns the vaporizer on or off.

WHEEL REPLACES HANDLEBARS ON BICYCLE BUILT FOR COMFORT

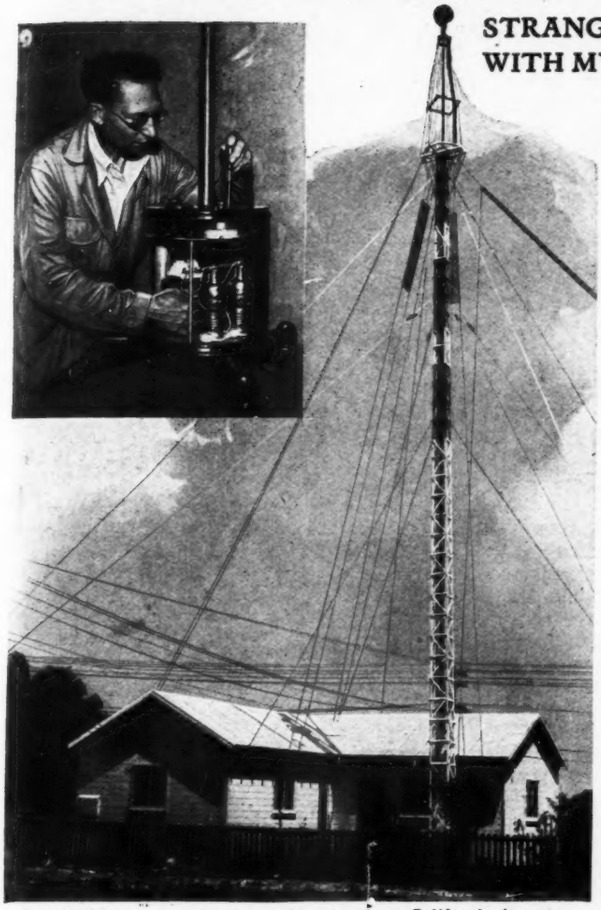
PEDALED from a comfortable position in a chairlike seat, a bicycle of new design has been introduced by an East Orange, N. J., woman inventor. Instead of handlebars, a steering wheel like that of an automobile guides the cycle. Its elongated frame provides an unusually low center of gravity, minimizing wabbling and danger of spills, and small wheels and an extra-long drive chain contribute to its novel appearance. The photograph shows a messenger boy trying out the new bike.

NEW GANGSTER WEAPON FITS PALM OF HAND

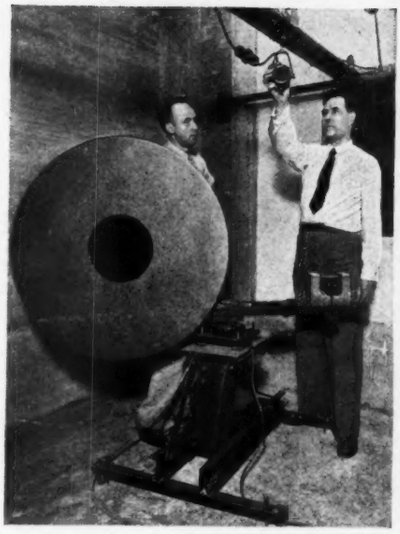
A TINY but deadly automatic, recently found by Federal men in a thug's possession, bears witness to the ingenuity of gangland's inventors. Squeezing the gun in the palm of the hand depresses a trigger bar, and the gun fires through a barrel between two finger loops. The weapon also serves the purpose of brass knuckles.

STRANGE RAY SOUGHT WITH MYSTERY TOWER

RISING high into the air above his bungalow workshop, a "mystery tower" just completed by a Palo Alto, Calif., experimenter attracts the attention of passers-by. A sphere surmounts the odd structure and cables radiate from it, some of which lead to an array of vacuum tubes and other electrical apparatus in an indoor laboratory. The builder of the tower professes to be experimenting with what he calls a "life-or-death ray," which, he maintains, will have the power of stimulating or killing; however, he declines to reveal to skeptical observers how such a ray might be produced or applied with the equipment that he has assembled, declaring only that the energy of the sun's rays will be utilized. Meanwhile, the mysterious tower continues to intrigue the curiosity of residents and visitors in the neighborhood.



In this laboratory, with its curious tower, a California inventor is conducting strange experiments. Inset shows him with apparatus



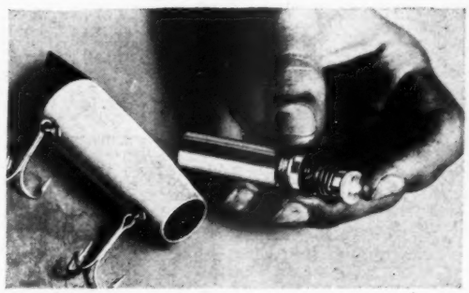
LOUDSPEAKER REVOLVES TO TEST SOUNDPROOFING

A REVOLVING LOUDSPEAKER, constantly emitting a warbling note as a motor whirls it upon its mounting, is aiding U. S. Bureau of Standards research workers to measure the effectiveness of sound-absorbing panels. The unusual device operates in such a way as to create a uniform "sound pressure" in its vicinity, permitting panels of various types of materials to be exposed to a similar barrage of noise for a comparison of their performance. In the photograph above, members of the Bureau staff are seen inspecting the new loudspeaker and the microphone connected with it.

STUDENT SEAMEN SHOOT THE SUN IN MOLASSES

MOLASSES helps train seamen in the use of a sextant, in navigation classes at San Francisco, Calif. By "shooting the sun," or observing its elevation above the horizon with a sextant, latitude and longitude are determined. If a natural horizon is not available, however, an artificial one must be improvised, consisting of a perfectly level surface that reflects the sun's rays. A dish of water will serve, but San Francisco instructors have found that a panful of molasses, because of its viscosity and consequent steadiness, works even better.

A student using the sextant, with a panful of molasses for an artificial horizon



New fishing lure with bulb and battery which light it

FISHING LURE IS ILLUMINATED

A LURE that contains a miniature electric light is an innovation for fishermen. Unaffected by water, the illumination is provided by current from a small battery of the type used in fountain-pen flash lights. Battery and lamp are fitted within the hollow wooden plug to which the hooks are attached. The new lure is declared especially suitable for night trolling.

EXAM PAPERS ARE GRADED BY WEIGHT

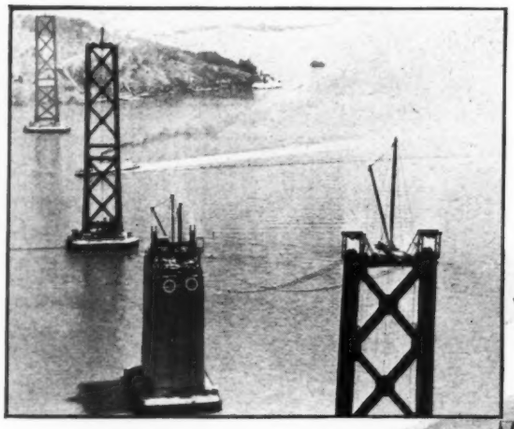
STUDENTS' examination papers are being graded with a weighing machine at a Kentucky teachers' college, where the new method has been found speedy and accurate. Each student receives a card bearing "true-or-false" and similar questions, and punches holes at indicated points to record his answers. When the card is placed in the weighing machine, small weights drop through the holes correctly punched and fall to a platter, where the total weight gives the score.

A card bearing punched answers is placed in the machine for grading

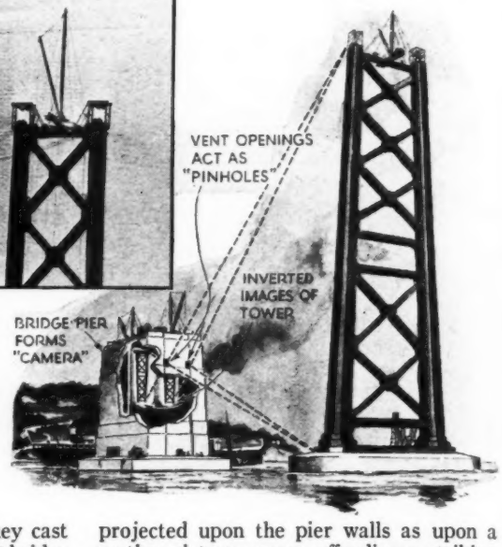
PASTOR CHISELS CHAIR FROM SOLID WOOD BLOCK

HEWING a chair from a solid tree trunk is the ambition of the pastor of an Alford, Mass., church. Equipped with a saw, brace and bit, chisels, hammer, and mallet, he began his long task last April and expects to finish it this fall. The block of maple on which he commenced work measured four and a half feet high and weighed more than a ton. In the photograph above, the work is seen at an advanced stage.

BRIDGE PIER FORMS PINHOLE CAMERA



The concrete anchor pier of the San Francisco Bay Bridge, which happens to form a camera obscura. The drawing below shows how images are projected in it



ENGINEERS have inadvertently built into the San Francisco Bay Bridge, now under construction, the biggest pinhole camera in the world. The interior of the concrete center pier, located midway between San Francisco and Yerba Buena Island, forms the dark chamber, and vents of one- by two-foot size serve as pinholes. They cast fifty-foot inverted images of adjacent bridge towers upon the opposite walls of the hollow pier. Images of passing ships are also projected upon the pier walls as upon a motion-picture screen, affording a striking spectacle to anyone who happens to be within the structure at the time.

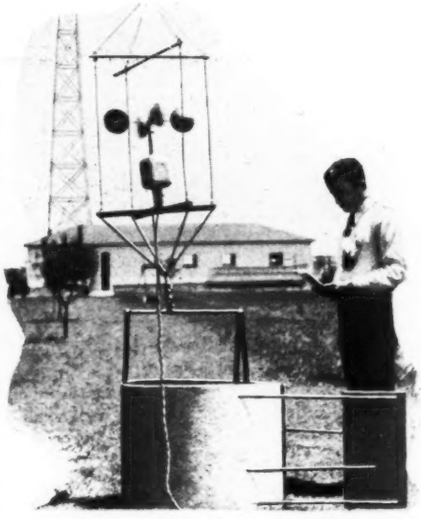
An outdoor library in a park in Madrid, Spain

PARK PROVIDES BOOKS IN OUTDOOR SHELVES

OUTDOOR LIBRARIES permit visitors to the public parks of Madrid, Spain, to enjoy reading with their relaxation. Concrete bookstalls place a wide variety of literature at the disposal of strollers, and bear polite inscriptions urging users to treat the volumes as carefully as their own and to return them promptly after use.

ROPE LIFTS WIND METER TO GET AIRSHIP DATA

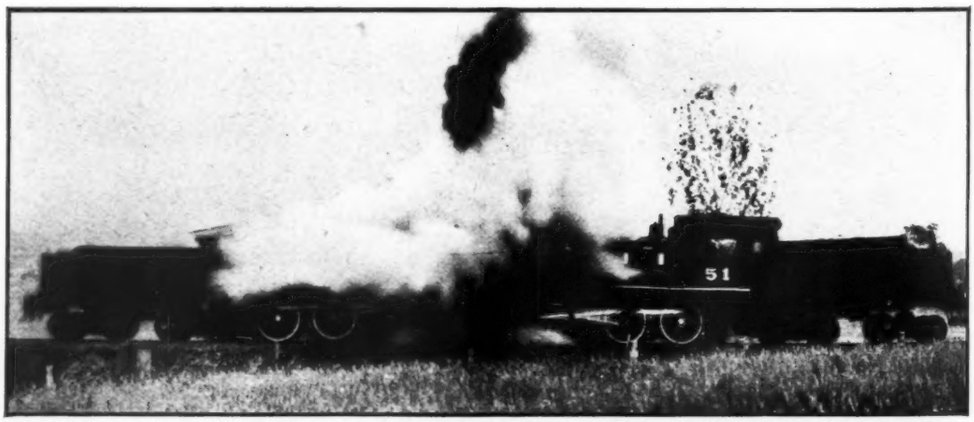
A RECORDING wind meter, raised and lowered by a cable attached to an Akron, Ohio, radio tower, is providing data to aid in handling and mooring airships. Engineers are using the device to study air currents near the earth's surface, and readings of wind speeds taken at various levels, in rapid succession, show clearly how air near the earth is slowed by friction.



Wind meter on cable which raises and lowers it

ENGINES COLLIDE TO THRILL CROWD

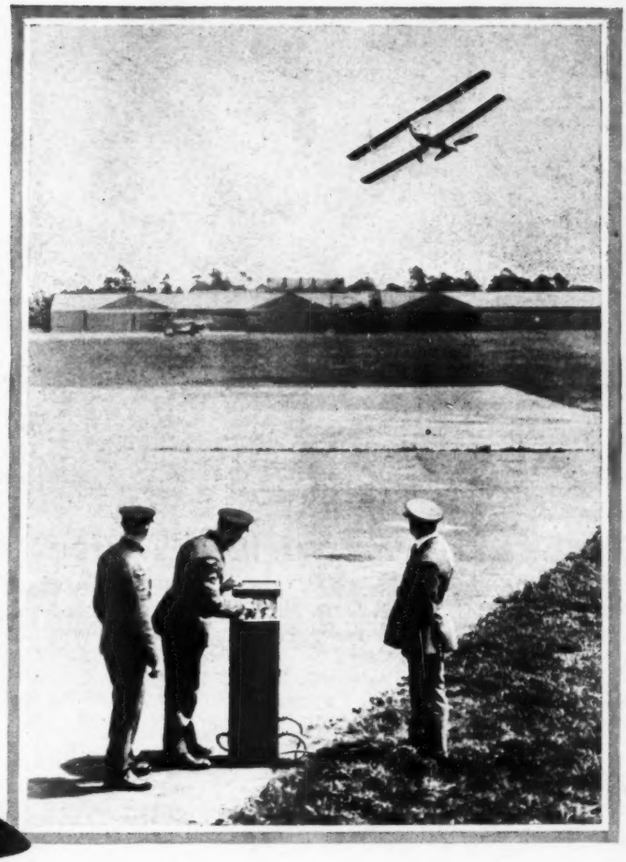
Two obsolete locomotives recently crashed head-on, near Magnolia, Ill., to provide a thrill for 8,000 spectators who paid admission to see the spectacle. After opening the throttles, the engineers leaped from the cabs, and the engines met with the devastating effect shown in the photograph at the right. The force of the collision may be appreciated from the position of the bucking locomotives, and the tenders rising off their trucks.



Two old locomotives colliding at full speed after the engineers have opened their throttles and jumped from the cabs

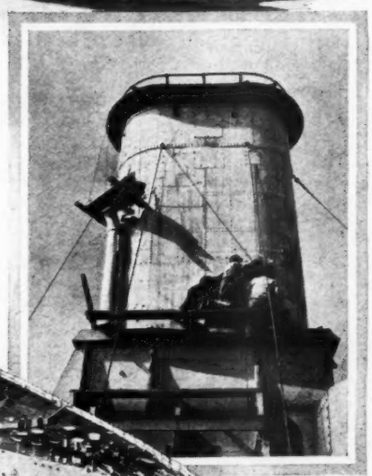
ROBOT WAR PLANE

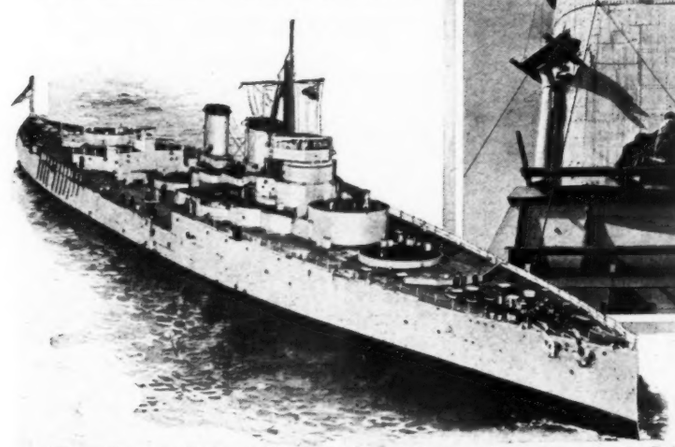
Flies without a Pilot



Britain's radio-controlled airplane is seen in action at the right, with officers directing its movements at the control box. At the left is a close-up of the box, showing buttons to direct plane's flight

The robot plane on the ground. It can take off, fly at 100 to 120 miles an hour, and return to its landing field without a pilot aboard





The radio-controlled warship *Centurion*, which is used as a target by the British Navy. At the right, workmen are patching the funnels where the big guns have registered hits

ITS COCKPIT empty, a fleet little biplane of the Royal Air Force roared over thrilled crowds at the Hendon, England, airport the other day. No pilot sat at its controls; the robot plane was being guided by radio. As an officer on the ground punched little, white buttons on a control box, the speeding machine obediently dived, looped, rolled, and finally swooped down to a perfect landing.

This was the public's first glimpse of a radio wonder that England has been developing for two years in attempted secrecy, though rumors of its existence have leaked out. The pilotless plane will take off from land or sea, fly at 100 to 120 miles an hour, and alight at the home port or on a warship's deck. Its flying range is announced as ten miles from the control station—and observers believe this is a conservative figure.

Several of the robot planes have been built for use as targets, and on at least two occasions, it is reported, have been brought down by antiaircraft fire. So far, their only announced purpose is to train gunners—like the radio-controlled battleship *Centurion*, probably the most-patched warship in the world, which for several years has been the target of the British Navy's guns. For both planes and ships operated by radio control, however, spectacular wartime possibilities are forecast. Pilotless planes of the type recently demonstrated could easily be fitted to drop bombs, so that they could attack and destroy enemy positions without risk to human personnel. Crewless warships, it has been suggested, could ram or blow up enemy vessels, sweep mines, block channels, lay smoke screens, and act as decoys. Recent technical advances open the way for speculation as to the part that such robots may play in the next war.

TRIES BATLIKE WINGS IN WIND TUNNEL

SEEKING to emulate Clem Sohn, stunt jumper who glided over a Florida airport on batlike wings (P.S.M., May, '35, p. 18), a woman aviator recently used the vertical wind tunnel at the Guggenheim Airship Institute, Akron, Ohio, to test her equipment. A terrific upward blast of wind enabled her to float freely, as shown by the slackened straps in the photograph, and try out her artificial wings in simulated flight. Like Sohn, she planned to drop from a plane, perform maneuvers with spread wings, and then land with a parachute.

GASOLINE-POWERED MODEL TOWS FULL-SIZE ROWBOAT

DESPITE its diminutive size, a twenty-eight-pound motor boat recently completed by a western model maker develops enough power to tow a rowboat, with two passengers, at a lively pace. The miniature towboat is guided by shifting the towing line to either side of the larger craft. A quarter-horsepower gasoline motor propels the model.

FINISH MAKES CORNCOB PIPE LOOK LIKE BRIAR

CORNCOB PIPES with a new finish, giving them the appearance of briar, are now on the market. The smooth, mottled coating is declared difficult for any but an expert to distinguish from real wood, and conceals the humble origin of the bowl without detracting from the smoking qualities that endear corncob pipes to their users. In the photograph above, the finish is partly scraped away to reveal the corncob bowl.

TEST PROVES BIG LUNCH SLOWS BRAIN

A HEAVY lunch slows down your thinking processes, according to Dr. Donald A. Laird, Colgate University psychologist, who bases his conclusion on a series of tests made with the odd apparatus shown in the accompanying photograph. Each subject of the tests held between his teeth a clamp connected with an electrical timing device that automatically recorded the time interval lapsing between a question and a reply. Subjects who had just dined heavily, Dr. Laird reported, required a longer average time to respond to questions requiring thought than those who had partaken of only a light meal, such as crackers and milk.

Timing device gauges speed with which subjects answer questions

ROBOT CRADLE ROCKER PUTS BABY TO SLEEP

ROCKING the baby to sleep is an easy task for a new mechanical robot, according to its Sikeston, Mo., inventor. Run by electricity, his device may be regulated to suit the most exacting infant, he declares, for adjustments will set it to execute any one of fourteen varieties of movements at any desired speed. Meanwhile, the mother is left free to go about her other household duties. A switch in the electric supply cable, shown in the photograph, enables the mother to stop or start the rocking as the mood of the baby may dictate.

NEW X-RAY PICTURES SHOW PROFILE

MORE lifelike than ordinary X-ray pictures are those made by a new German method, showing the subject's profile as well as the structure of his bones. The effect is obtained by coating the skin of the subject with a special ointment that renders it partially opaque to the rays, which ordinarily pass freely through flesh and muscle and cast shadows only when they encounter bone. X-ray pictures of the new type have been found to aid medical diagnosis in cases where the relationship of bones and surrounding tissue is a factor.

Cutting the World's Biggest Diamond

1 AFTER THE DIAMOND IS STUDIED FOR FLAWS AND GRAIN, IT IS MARKED FOR CUTTING AND CLEAVING.
2 A PLASTER CAST OF THE STONE IS USED AS A MODEL DURING THE WORK
3 AS THE FIRST STEP IN CLEAVING, THE STONE AND A KNIFELIKE PIECE OF ANOTHER DIAMOND ARE CEMENTED TO THE TOPS OF HOLDING TOOLS
4 WORKING AGAINST STEEL PINS AS FULCRUMS, THE DIAMOND CUTTER RUBS THE KNIFELIKE PIECE OF STONE ALONG LINE WHERE DIAMOND IS TO BE SPLIT UNTIL GROOVE IS FORMED
BIN COLLECTS DIAMOND DUST
WIRE MESH CATCHES CHIPS OF STONE
CLOSE-UP OF WEDGE IN GROOVE
5 A TAP ON BLUNT WEDGE INSERTED IN GROOVE SPLITS THE DIAMOND (THE STONES ARE ALWAYS CUT ACROSS THE GRAIN, CLEAVED WITH IT)
COUNTERWEIGHT
DIAMOND IN UNIVERSAL HEAD TILTS AT ANY ANGLE
FEED SCREW
CUTTING WHEEL
6 THIN WHEEL OF PHOSPHOR BRONZE CHARGED WITH DIAMOND DUST WHIRLS AT 5000 R.P.M. TO CUT ACROSS THE GRAIN
BIN COLLECTS CHIPS AND DUST
7 BY MEANS OF SPECIAL LATHE, HIGH SPOTS ON STONE ARE SMOOTHED OFF AGAINST ANOTHER DIAMOND
LEAD WEIGHTS PRESS DIAMOND AGAINST WHEEL
CLAW TEETH GRIP DIAMOND IN NEW-TYPE HOLDERS
STONE SET IN COMPOSITION OF LEAD AND TIN IN COMMON HOLDERS
GAUGES MEASURE ANGLE OF FACES AS STONE IS GROUND (THE PURPOSE OF GRINDING IS TO PRODUCE FACES THAT REFLECT LIGHT FROM ONE TO THE OTHER AND BUILD UP THE BRILLIANCE OF THE STONE)
8 THE FINAL STEP IS GRINDING AND POLISHING ON A HIGH-SPEED WHEEL COATED WITH OLIVE OIL AND DIAMOND DUST

AS THIS issue of POPULAR SCIENCE MONTHLY goes to press, the world's largest uncut gem, the million-dollar Jonker diamond, is being studied by Lazare Kaplan, the New York expert who will have charge of cutting, grinding, and polishing the great stone. This delicate task will consume six months or longer.

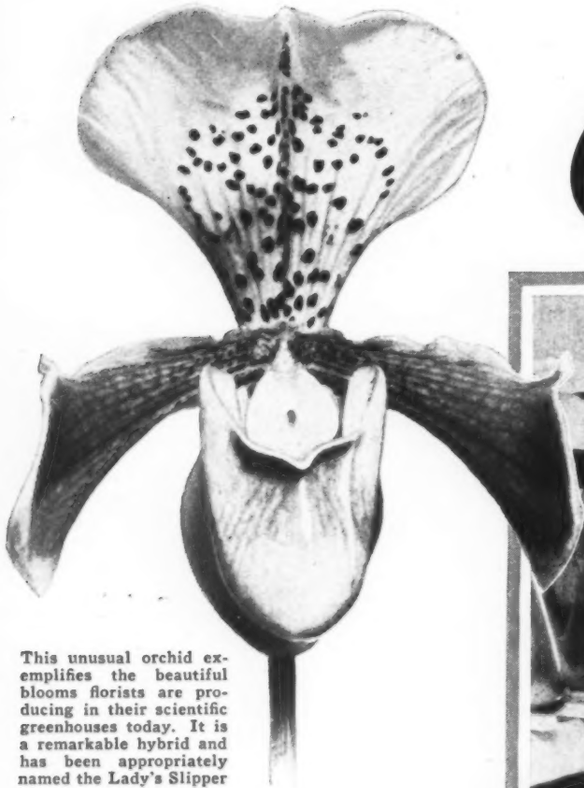
Picked up last year by a South African farmer, the rough stone weighs 726 carats, or about five ounces. It is larger than a hen's egg. Three diamonds found in the past, the Kohinoor, the Excelsior, and the Cullinan, have been heavier, but the Jonker is the most nearly perfect big diamond ever found.

The steps which will bridge the gap from the rough stone, seen in the photograph at the top of the page, to a finished jewel, such as is shown at the right, are depicted here by our staff artist through the coöperation of the expert who will do the work.

Drawings by B. G. SEIELSTAD

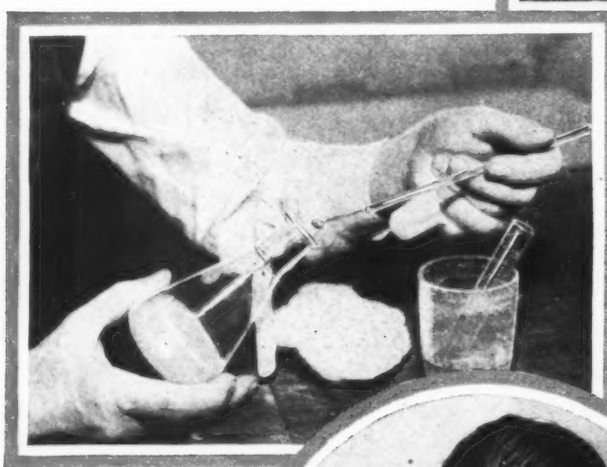
Science Rivals Nature

IN PRODUCING BEAUTIFUL *ORCHIDS*



This unusual orchid exemplifies the beautiful blooms florists are producing in their scientific greenhouses today. It is a remarkable hybrid and has been appropriately named the Lady's Slipper

In these stoppered jars with beds of agar-agar, orchid plants are nursed through the first twelve to eighteen months of their lives. They can then be taken from the incubator house and transplanted to community patches



By means of a sterilized platinum wire, hundreds of tiny orchid seeds are planted on agar-agar in incubator jars. Previously, the seeds have been sterilized in lime water

A laboratory assistant determines when the young plants are sturdy enough to leave the incubator. Using a magnifying glass, he examines each culture very closely before signifying that it is ready for transplanting to the hothouse beds of peat

Here an operator using a wooden spoon "fishes" year-old orchid plants from an incubator jar. The plants are then separated and placed individually on a strip of moist canvas, preparatory to transplanting to beds of peat fiber. These pictures of orchid culture were taken in the greenhouses of Armacost and Royston, Inc.

This unusual orchid bears the name of Bird of Paradise. The bloom resembles the head of an exotic bird. This strange member of the orchid family is native to the Canary Islands

The Amazon lily, a large Anthurium, is a giant relative of the orchid. It is easily grown if moss is matted around the stalk to provide moisture for the roots and stem. This will save needless repotting

Most of us think of orchids as being able to exist only in hothouses or in the tropics. Here is one that thrives in a colder climate. It is a Cymbidium spray orchid, a native of the South American Andes and one of the few members of this tropical family able to withstand cold

An extraordinary variety of orchid known as Phaleonopsis is grown embedded in an open basket held suspended on its side. This allows circulation of air and good drainage, and permits the water-bearing roots to trail. The orchid is a native of the Philippine Islands

Orchids are prolific seed producers. A single pod often yields as many as a million seeds. In tne picture at the left, a typical pod filled with tiny seeds is being held open. The pods ripen in a period of six to twelve months

What Animals Know *about* Medicine

By *Frank Clay Cross*

Standing on their hind legs, these deer are eating twigs for their medicinal value. At the right, a moose is seen diving in a lake for wild-lily roots

Lions with a kill. Carnivorous animals get their necessary supply of vitamins from the internal organs of their prey

CALL the doctor! You are sick and you want medicine to make you well again. Or maybe you have broken an arm or a leg, or have injured yourself in some other way. Whatever the trouble, if it has to do with your health and physical fitness, you know just what to do. You call the doctor.

What do wild animals do under similar circumstances? They have no doctors. Every creature must take care of itself when it falls sick or receives an injury. It usually does an excellent job, too, according to Dr. Wilborn J. Deason, of Chicago, who has hunted and studied wild life all over the world.

"Animals have an instinctive knowledge of how to doctor themselves when they get sick," Dr. Deason says, "and an even better knowledge of how to keep well. They know the use of laxatives, and they knew about vitamins long before human doctors learned how important they are for the prevention of disease. They know the value of sunlight in the treatment of certain ailments, and the value of shade and quiet in others. They know the importance of hygiene, and how to take care of injuries. Some of them even know how to set broken bones."

About twenty years ago, the world became very conscious of vitamins, which had been discovered by an English biochemist, F. Gowland Hopkins, in 1906. Since then, many new discoveries about them have been made. We have learned that there are a whole series of them, which affect our health in different ways. One fortifies our bodies against common colds and other germ diseases, and prevents a very troublesome type of sore eyes. Another is essential to the maintenance of a good appetite and the growth of the body. Another prevents hemorrhages and aids in bone building; another prevents rickets; and still another is necessary to the reproduction of the species.

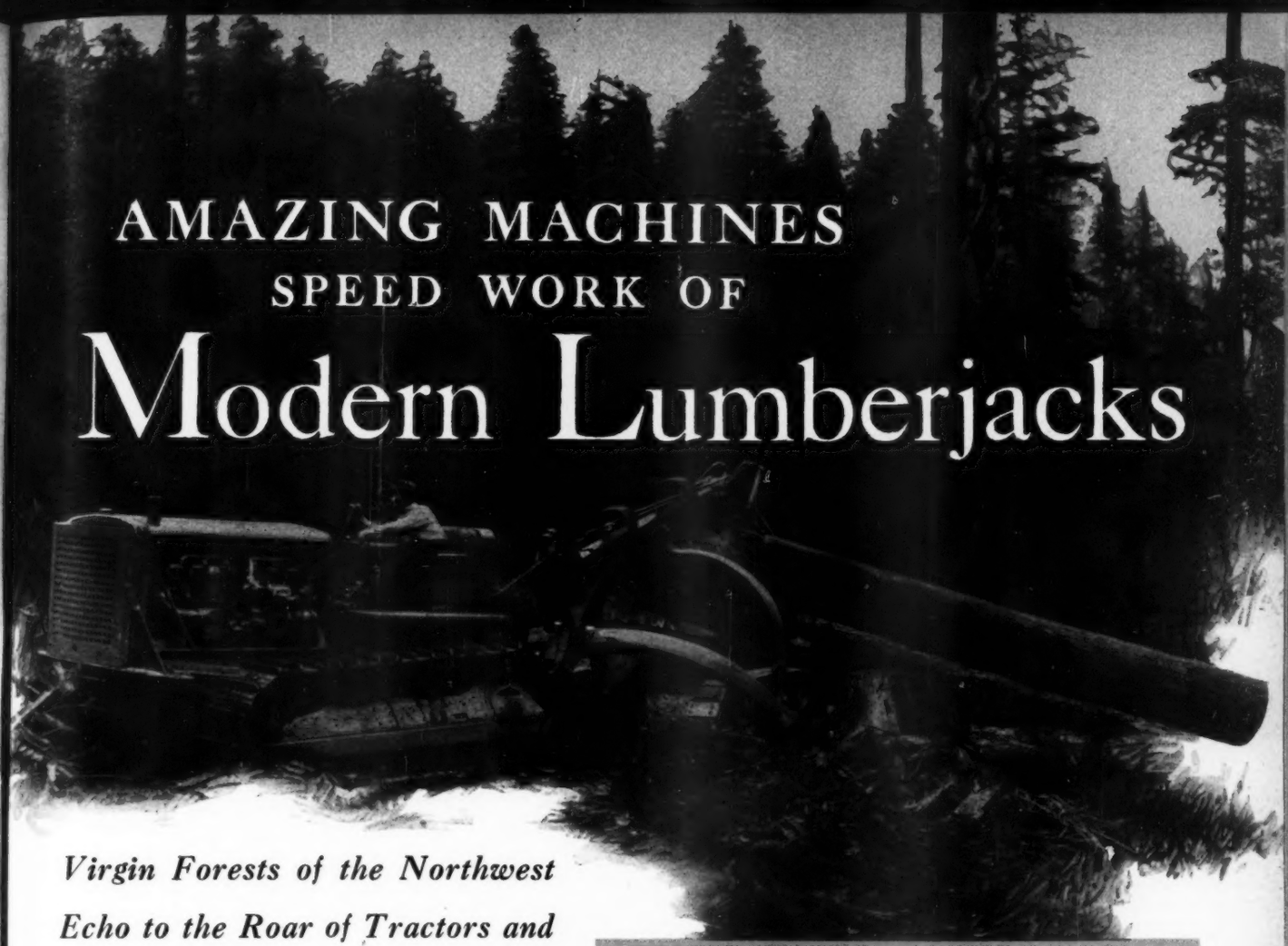
When bears come out of hibernation, they hunt berries which have a laxative action, to put themselves in condition

The discoveries of F. Gowland Hopkins and his successors awakened us to the importance of fresh green vegetables in our diet, and to the healthfulness of carrots and beets and certain other roots. Later we learned that vitamins also are present in liver and in other meat foods made from glandular organs. This knowledge is as old as creation among animals.

When the green grass begins to come up in the spring, every cow, horse, and sheep immediately makes for the fields. The dry hay, which they have eaten all winter, attracts them no longer. The grass may be short, and they may have to graze all day to get a meal equal to what they could eat in an hour at a haystack, but that makes no difference to them. They seem to know instinctively that green grass contains the extremely valuable vitamin A, which prevents eye diseases and raises the resistance of the body against many kinds of germs.

Dr. Deason tells of watching moose diving to the bottoms of lakes in the Northwest to *(Continued on page 106)*

AMAZING MACHINES SPEED WORK OF Modern Lumberjacks



Virgin Forests of the Northwest Echo to the Roar of Tractors and the Whir of Gasoline-Driven Saws

By JOHN E. LODGE

TWO HUNDRED feet up a giant Douglas fir in western Washington, a veteran high-climber wires twelve sticks of dynamite in a ring around the trunk, slides fifty feet earthward, and awaits the explosion which blows off a three-ton section of the tree top.

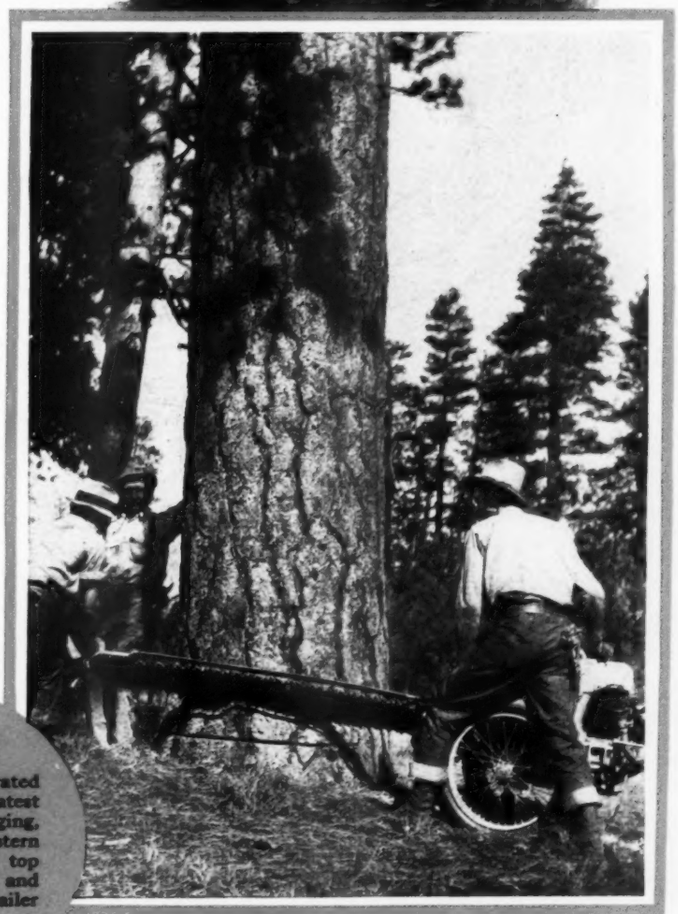
On the foaming Clearwater River in Idaho, 100 sure-footed lumberjacks drive enough logs to the mill each spring to build a city. From Clatskanie, Ore., two or more giant log rafts set sail each summer on a 1,100-mile voyage down the Pacific coast to San Diego, Calif., each carrying 5,000,000 feet of timber to a distant mill.

Men of brawn, aided by the latest machines of science and mechanics, push farther every year into primeval forests of the Northwest.

Ox teams and skid roads have disappeared. Now you hear of steel-spar skidders, sky-line cables, and power saws; of steam and electric and Diesel engines lowering the cost and increasing the speed with which mammoth trees are cut, skidded, loaded, and transported to the big mills.

Winches attached to tractors move logs through dense forests with the ease of switch engines shifting strings of empty freight cars. Other tractors pull miniature cranes, known as arches and hoists, which lift one end of each log clear of the ground and then pass over fallen trees and climb mountain sides to waiting trains.

At Shelton, in the rainy Oxbow region of western Washington, a crew



A gasoline-operated saw, one of the latest innovations in logging, undercutting a western yellow pine. At top of page, a tractor and arch-and-hoist trailer

A tractor and a log yarder working together to load logs on railroad cars. At the right is shown a recent shipment of giant logs cut from two trees in an Oregon forest

recently felled one of the biggest logs ever to be cut in an American timber stand. The giant stood 300 feet tall and measured ten feet in diameter at the top. The saw bit through the fourteen-foot base in jig time and, when measurements were made, the log was found to contain 17,000 board feet of wood.

Pressing ahead through a forest of fir, hemlock, and spruce near Cathlamet, Wash., early this summer, a crew of twenty-one men set a new world's record. In a single day, they cut, skidded to the near-by railroad, and loaded 480 logs on 130 cars —a total of 1,661,975 board feet of timber. A powerful machine known as an interlocking steel-spar skidder, with power derived from a superheated-steam boiler, pulled the logs, in loads weighing up to forty-five tons, down hills and across ravines, and laid them on waiting flat cars.

Recently, there have appeared in the woods several types of motor-driven saws, replacing the age-old, two-manpower crosscut saw, which help make these records possible. Some of these saws are powered by small gasoline engines carried on rubber-tired wheels while others are driven by portable electric-power plants. Loggers sink the sharp teeth of these modern saws into log-size trees only six inches above the earth, thus recovering logs a few inches longer than formerly was possible.

In a test on a large flat near Priest Lake, Idaho, these latest saws ate into tamarack, hemlock, fir, cedar, and pine trees far faster than the most skilled human fallers ever severed the trunk of a forest tree. At Priest Lake was ushered in a new era of logging.

Each wood cutter consists of a sturdy steel blade along which races a chain of linked teeth. A sprocket connected with the power unit pulls the chain around the ends of the blade. Such saws cut their own trail as they advance on their mobile carriages from tree to tree.

In some forests, steel spars rear their powerful frames 100 feet into the air that logs may be dragged swiftly by aerial cables, known as high leads, over the ground or lifted into the air across ravines to waiting cars. But the tall spar trees—glorified stumps—continue to bear the brunt of logging operations. They are the anchors to which newly felled logs are dragged.

High-climbers "walk-up" the tall trees selected as spars and dynamite the tops off into space—the most dangerous job woodsmen face today. A tree may split and cause the high-rigger's safety rope to squeeze him to death. The top may drop in the wrong

Using a long sweep, a lumberman steers a raft of logs as it shoots the rapids of a turbulent river

In huge floating cradles like the one shown below, rafts containing as much as 5,000,000 board feet of lumber are assembled and launched

direction or the safety rope may break despite the great strength of its steel core.

Not long ago, Andy Johnson tossed his twenty-five-foot rope around a giant fir near Seattle, Wash. Setting his 2½-inch steel spurs into the thick bark, he tossed the loop up, drew it taut, and climbed. From his belt dangled a long saw; through a loop he carried a sharp ax. Quickly he climbed, limbing the tall tree as he ascended. Some thirty feet from the top, where the trunk had tapered to a diameter of two feet, he fastened the free end of the rope in his belt. Then he undercut the tree with his ax, moved around, and began sawing from the back.

When he had sawed two-thirds through, the two-ton top leaned slightly, then it snapped! Striking the stump top with its butt, it hurtled into space. An invisible defect doomed the high-rigger, for as the top fell, the tree split, swelling against the taut rope. The steel core parted under the pressure, dropping the man 150 feet to his death.

Trees do not always respond to topping in the same way. When the top falls in a graceful arc, the tree swings, sometimes in a circle, again in a spiral, through a radius as great as twenty feet. Veteran high-climbers ride the swaying tops with the abandon of cowboys riding bucking broncos—and sometimes with unexpected results.

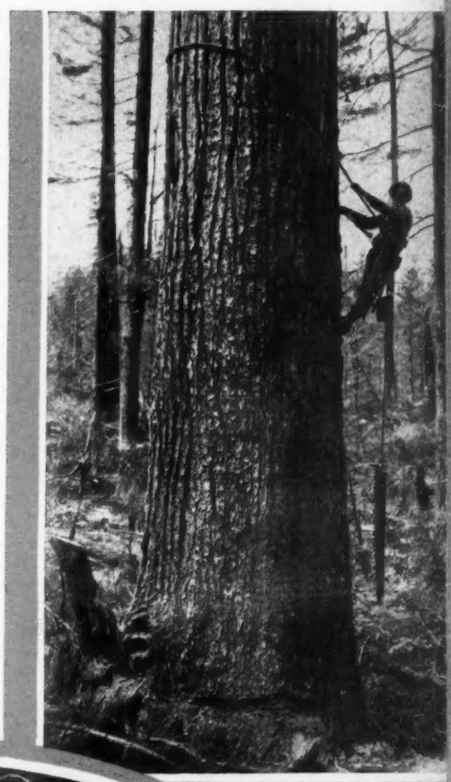
One man cut the top from a tall fir in the Skagit watershed of western Washington recently, reached back to adjust his ax in its loop—and turned a somersault in his belt. Unable to right himself, he hung head down for an hour, his back against the tree, until equipment could be rushed to the scene and another high-climber came to his rescue.

These wizards of the forests perform some amazing feats. Logging crews often move 200-foot trees a hundred yards or farther without lowering them to the ground. The tree is given a V-shaped cut, top guy lines are held taut, and a donkey engine skids the base along the side of a log placed horizontally at the base. Every twenty feet the guy wires are shifted to keep the tall spar upright during its journey to a new location.

Sometimes, in rigging and dismantling spar-trees, the high-climbers meet with freak accidents which, fortunately, do not always have dire results. One veteran of the tall trees, after knocking off the last supporting wire from a 125-footer which had been raised in soft ground, suddenly felt the tree sway, then fall. He rode the top all the way to the ground, doomed, it seemed, to certain death. But he dropped into a pit filled with tops and brush, and escaped with no more serious injuries than a few broken bones.

Despite the growing use of modern machinery, loggers in Idaho still thrill to the historic river drive. Where once 40,000 lumberjacks, agile as cats, drove logs down boiling streams from forests to mills, today no more than 200 rivermen engage in this hazardous enterprise. The drive from Potlach Forest on the seething Clearwater is the only sizable log drive in the United States.

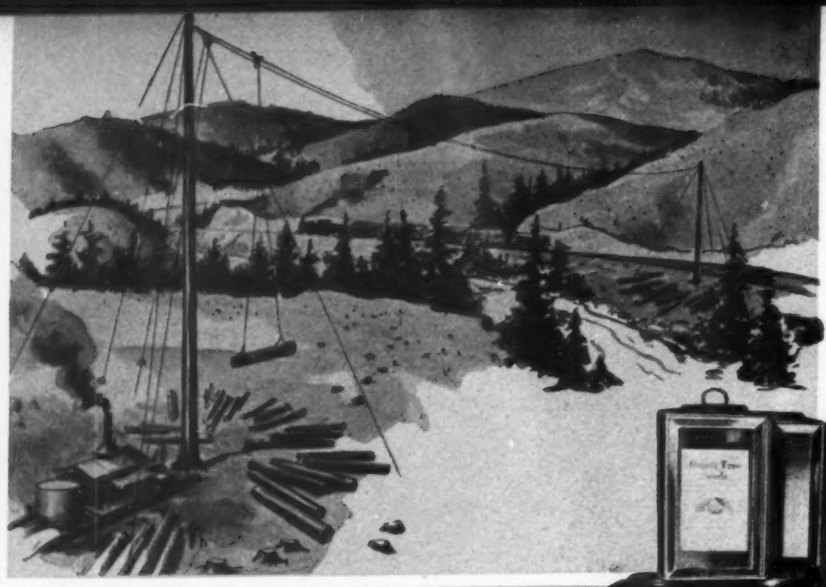
Throughout the winter, loggers cut trees and send the logs down wooden flumes to the river. Provided the river is high enough, the logs drift down to the mill at Lewiston, Idaho, in midwinter. But many jam along the way and, in the spring, gangs of men



THE THRILLS OF LOGGING

At the right, a high-climber is starting up a big Douglas fir which is to be used as a spar tree. He will cut off a three-ton section at the top. Below, eight men on the run to get out of the way as the signal is given for the aerial cable to pick up a heavy log

The high-climber clings to the end of the spar tree as the three-ton top kicks free and falls in a graceful arc to the ground 180 feet below. This is one of the spectacular phases of logging



This drawing shows how spar trees are used to support aerial cables which carry logs over long distances

The cans in the picture below contain seeds of Douglas fir trees, gathered as part of the reforestation plan fostered by Government and industrial agencies for conservation

move into the timber and start thousands of strays down from small eddies. The Clearwater drive continues from three to five weeks, until the last log reaches the saws.

Birling logs in tumbling white-and-green water is no job for a weakling. Few men have fallen into a stream while breaking a log jam and survived. One riverman lost his peavey, the cant hook used to turn and shove logs, and then fell. For two hours he was battered as thousands of logs raced downstream. Miraculously he was thrown ashore at a bend in the river, still alive but with both legs shattered and his head swollen to double its normal size from the terrific pounding he had suffered.

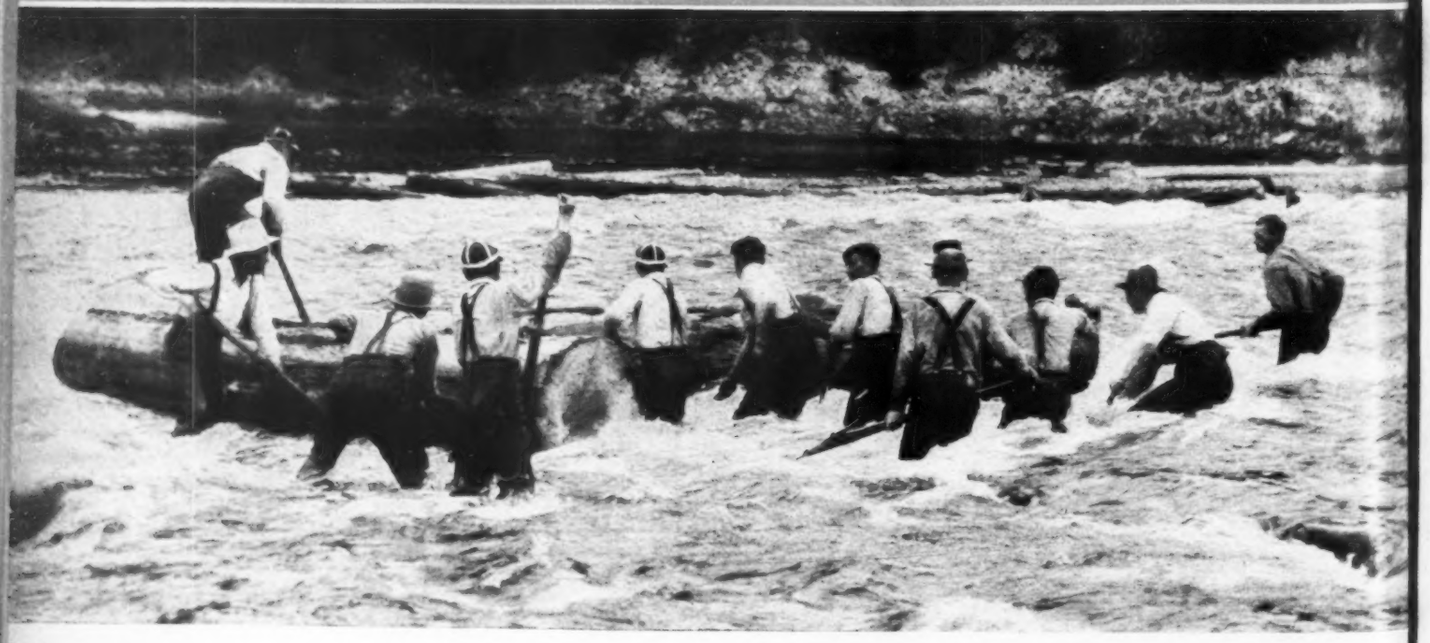
On the rushing Clearwater, if a riverman loses his peavey while breaking a jam, he has no choice but to "ride it out." If he loses his balance, he drops into a hell of pounding logs and roaring water.

Fortunately, most of the rivermen are expert birlers, able in their sharp-calked boots to ride spinning logs. In one contest two lumberjacks kept their logs spinning on three successive days for a total of twenty hours before one fell off, thoroughly exhausted.

In the most novel of all logging enterprises 105 sea-going "cigars," each longer than three city blocks, have been towed virtually without incident the length of the Pacific coast during the last three decades. The rafts are formed in great wooden cradles, launched, pulled out into the Pacific from Clatskanie, Ore., and delivered two weeks later to a mill in southern California.

Only three times have log rafts found themselves in serious trouble at sea, despite the many storms through which these leviathans have sailed. Once a raft broke loose and actually was lost off the southern California coast. Two weeks later a passing ship sighted the wallowing derelict and reported the find to navigation authorities. On two *(Continued on page 107)*

Knee-deep in boiling rapids, a dozen lumbermen struggle to dislodge two big logs that stuck in shallows on the way to the mill



This German car has a wood-burning hopper at the rear, in which it generates its own fuel gas

NEW AUTO USES WOOD OR GASOLINE FOR FUEL

IF THE driver of a new German car runs out of gas on a country road, a trip to the nearest wood pile will replenish his fuel supply. The motor of this versatile machine will run either on gasoline, which is carried in a tank, or on fuel gas, which is generated by burning wood in a hopper built into the rear deck of the machine. According to the designer, a motorist who drives his car 100 miles a day could operate it for nearly a month on a single cord of wood. Using this fuel, the machine is reported capable of a speed of more than sixty miles an hour. Gasoline is carried only as an auxiliary source of power to be used in areas where wood is not readily obtainable along the open road. Despite its unusual features, the new car in outward appearance resembles a standard model. In the photograph at the left, the driver is seen replenishing the wood-burning hopper on the highway.

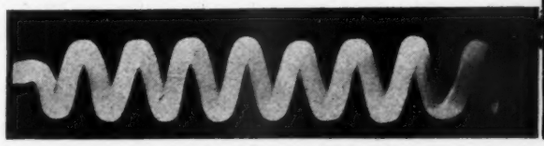
Dry spray from this fire extinguisher will do no damage

EXTINGUISHER SMOTHERS FIRE WITH DRY CHEMICAL

A COMPACT hand fire extinguisher of new design, recently placed on the market, shoots a dry chemical compound that is said to smother flames without damage to materials that it strikes. The chemical is contained in a bulbous head, which is made ready for use by knocking aside a spring clamp covering the nozzle. A pump handle sprays the compound. When the chemical has been used up, a "refill" head may be substituted, or the original one may be replenished from three-pound packages of the chemical.

LAMPS ARE LIGHTED BY GLOWING GERMS

LIVING lamps, made from phosphorescent bacteria, have been created by research workers of Vienna, Austria. Laboratory cultures of the germs, which appear on decaying fish, are obtained from herring and grown in a bouillon culture medium. By coating the inside of a flask or a spiral of glass tubing with gelatin, and then "vaccinating" it with a culture of the self-luminous bacteria, lamps of surprising brilliance are obtained. The experimenters propose that the living lamps, if perfected, might be put to practical use in places such as powder magazines, where flames or electricity present hazards. They can also be applied in producing decorative effects for Christmas-tree or theatrical use. Luminous paint made from the germs has already been employed to produce novelty posters advertising scenic attractions and soliciting contributions for charitable causes. Thus far, it has been possible to sustain a bright light for about two days.



A research worker prepares a culture of phosphorescent bacteria from a herring. The poster at the right was drawn with a paint containing these organisms. Around it are some glowing cultures. The spiral below is a culture-filled glass tube

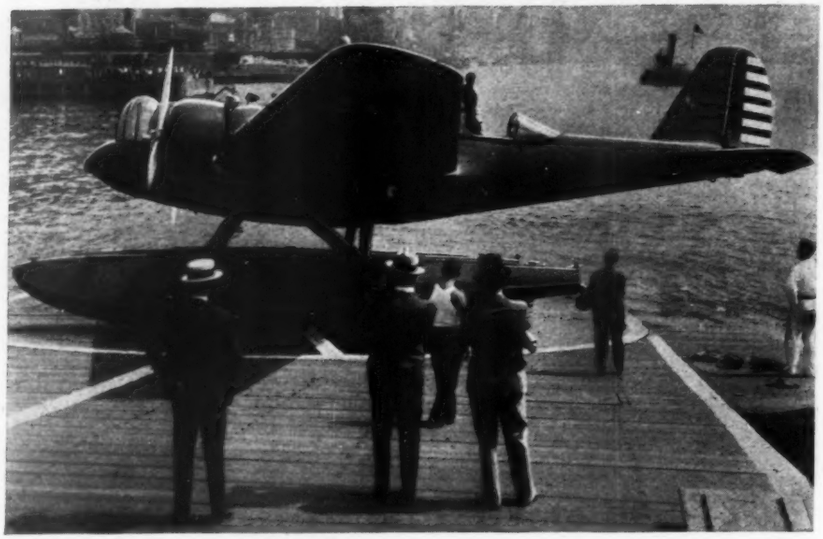
TWIN-HULLED SPEEDBOAT RESEMBLES AIRPLANE

LOOKING more like an airplane than a speedboat, the hybrid Italian water craft pictured at the right recently proved its mettle and stamina in a 270-mile motorboat race from Milan to Venice. Twin hulls, shaped like airplane fuselages, accommodate the pilot and his mechanic, and an air propeller of tractor type, supported with its motor on streamlined struts, propels the unusual craft. Two rudders, one mounted at the rear of each hull, operate in unison for steering. The double-hull design is reported to give more than ordinary stability, reducing the danger of capsizing when the boat is driven around sharp turns at high speed.

ELECTRIC GLOVE HELPS POLICE QUELL RIOTERS

AN ELECTRIC glove, recently demonstrated before New York police officials as a substitute for the traditional "billy," is declared by its inventor to provide a humane and effective means of subduing rioters. A touch with the glove is enough to take all the fight out of the most recalcitrant disturber, since it imparts an electric shock with a kick of 1,500 to 5,000 volts behind it. The paralyzing effect, however, is only temporary, and there are no burns or other after-effects. A small battery carried on the hip, a spark coil to produce the high voltage, and the glove itself, which is insulated from the wearer's hand, comprise the police officer's equipment. A thumb switch regulates the charge so that the top voltages are applied only in stubborn cases.

FAST BOMBER GETS SEAPLANE TEST



FOLLOWING the success of its 200-mile-an-hour Martin bombers in land maneuvers, the U. S. Army recently equipped one of the planes with pontoons for a test of its ability to defend a coastal city in time of war. Descending on the East River in New York City, the machine made a satisfactory landing and getaway at a recently constructed seaplane ramp and turntable, as shown above.

Wheel is detached when the locking plate is turned. Right, wheel ready for removal

ONE MOTION DETACHES NEW DEMOUNTABLE AUTO WHEEL

A SINGLE turn of the wrist suffices to detach a new demountable auto wheel. The action revolves a locking plate and disengages it from five lugs upon the hub, permitting the wheel to be removed and replaced. When the spare wheel is in position, a turn in the opposite direction, applied with a wrench to a master nut, re-ëngages the plate and thus securely locks the new wheel to the hub.

HAMMER HAS ROLLER TO PULL NAILS

A ROLLER-BEARING hammer, recently introduced, conserves effort and prevents marring of woodwork when a nail is to be pulled out. Built into the head, the roller serves as a fulcrum and allows the hammer head to move toward the nail as the latter is withdrawn without bending. Long nails can be pulled without using a block.

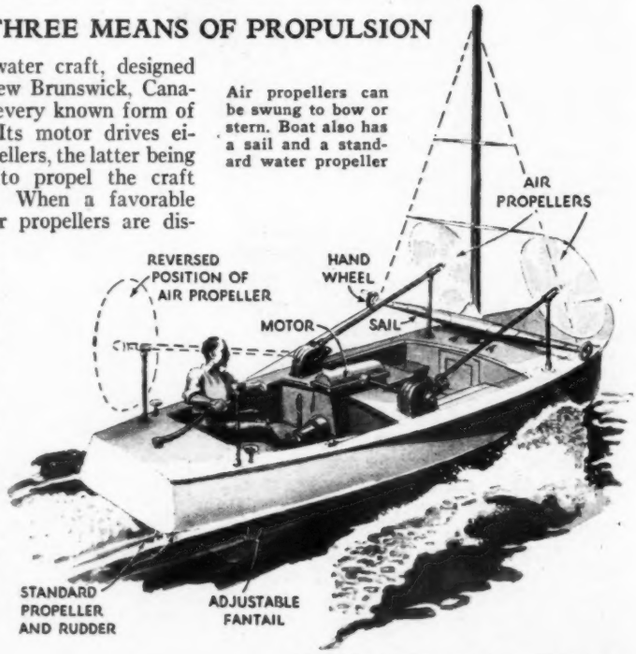
FISH HELP SCIENTISTS

FISH that swallow other fish sometimes aid scientists in obtaining rare specimens. In one instance, the stomach of a large catfish yielded the hitherto unknown infant stage of the great Caspian sturgeon.

BOAT USES THREE MEANS OF PROPULSION

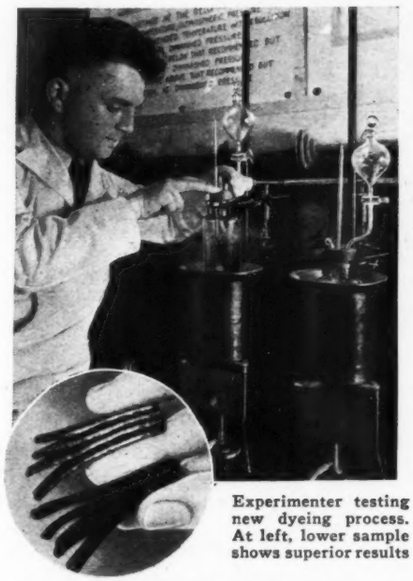
A FREAK among water craft, designed by an inventor of New Brunswick, Canada, combines nearly every known form of marine propulsion. Its motor drives either water or air propellers, the latter being reversible in order to propel the craft from bow or stern. When a favorable breeze blows, the air propellers are disconnected and swung to the rear, and a sail is raised on a mast at the forward end of the boat. A plane or "fantail" beneath the stern may be lowered to check the bow from rising from the water at high speed and to provide a planing action. The water propeller may be raised, the inventor states, permitting the boat to negotiate shallow channels.

Air propellers can be swung to bow or stern. Boat also has a sail and a standard water propeller



VACUUM DYEING PROCESS YIELDS BETTER COLORS

PROMISING better and brighter colors for wool fabrics, a new British dyeing process employs dye solutions boiling in vacuum vessels, at temperatures far below the usual boiling point. The reduced temperatures, tests show, favor rapid and thorough penetration of the fabric by the dye. Another method found effective is to keep the dye solution below the boiling point and bubble air through it.



Experimenter testing new dyeing process. At left, lower sample shows superior results

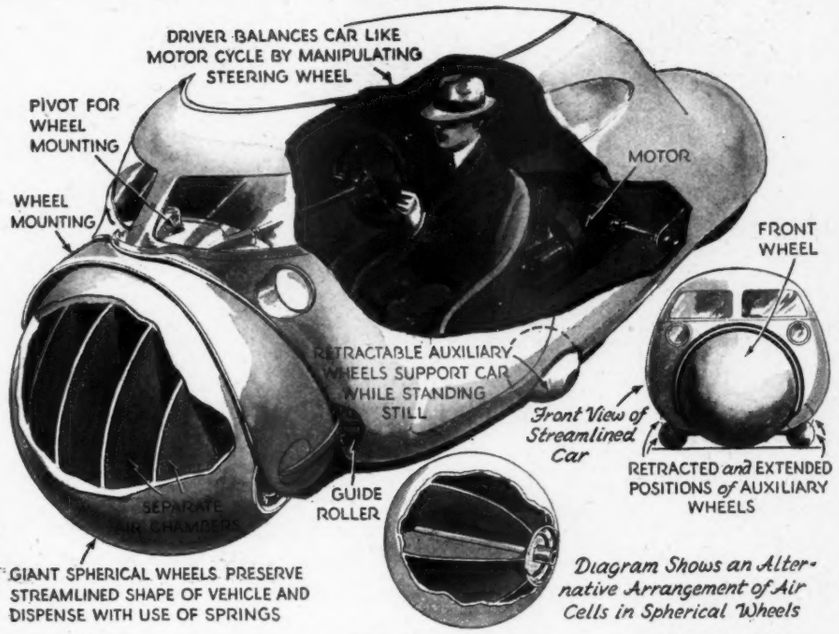

DRIVER BALANCES CAR LIKE MOTOR CYCLE BY MANIPULATING STEERING WHEEL
PIVOT FOR WHEEL MOUNTING
WHEEL MOUNTING
MOTOR
FRONT WHEEL
RETRACTABLE AUXILIARY WHEELS SUPPORT CAR WHILE STANDING STILL
Front View of Streamlined Car
RETRACTED and EXTENDED POSITIONS of AUXILIARY WHEELS
GUIDE ROLLER
SEPARATE AIR CHAMBERS
GIANT SPHERICAL WHEELS PRESERVE STREAMLINED SHAPE OF VEHICLE AND DISPENSE WITH USE OF SPRINGS

Diagram Shows an Alternative Arrangement of Air Cells in Spherical Wheels

SPHERES REPLACE WHEELS ON ODD CAR

A MOTOR CAR that runs on air-filled spheres, instead of wheels and tires of conventional form, is the invention of a German designer. All parts of the new vehicle, he maintains, merge into a highly streamlined shape, thus minimizing air resistance. The globe-shaped tires require no mudguards, and dispense with the need of springs to absorb road shocks, also reducing skidding and serving as bumpers in the event of a collision. Multiple air chambers prevent sudden deflation, with its attendant dangers, if a puncture should occur. In the proposed design, the car runs on a pair of pneumatic spheres at front and rear, and the driver balances it like a motor cycle by manipulating a steering wheel. Small auxiliary spheres may be extended to hold the car upright while it is standing still or getting under way.

CRANK RUNS ONE-MAN MERRY-GO-ROUND

PROPELLED by turning a hand crank, a one-man merry-go-round devised by a Californian gives an exciting ride. A person of ordinary strength, it is said, can develop a velocity of forty-five miles an hour. Larger models for playgrounds accommodate several persons, while miniature rides of the same type may be enjoyed safely by small children.

New dripless ice-cream holder as sold, and with plunger in action

ICE-CREAM HOLDER IS DRIP-PROOF

DRIPLESS ice-cream cones are a novelty recently introduced by an Ohio manufacturer. The innovation consists of a cylinder filled with ice cream, which is ejected by a plunger on a stick as fast as it is consumed. A sanitary transparent wrapping protects the ice cream from contamination between the time of filling, at a dairy, and its sale to a customer, as shown in the illustration.

SPRING GRIP HOLDS CORD PLUG TIGHT

Spring-grip terminals give tight connection

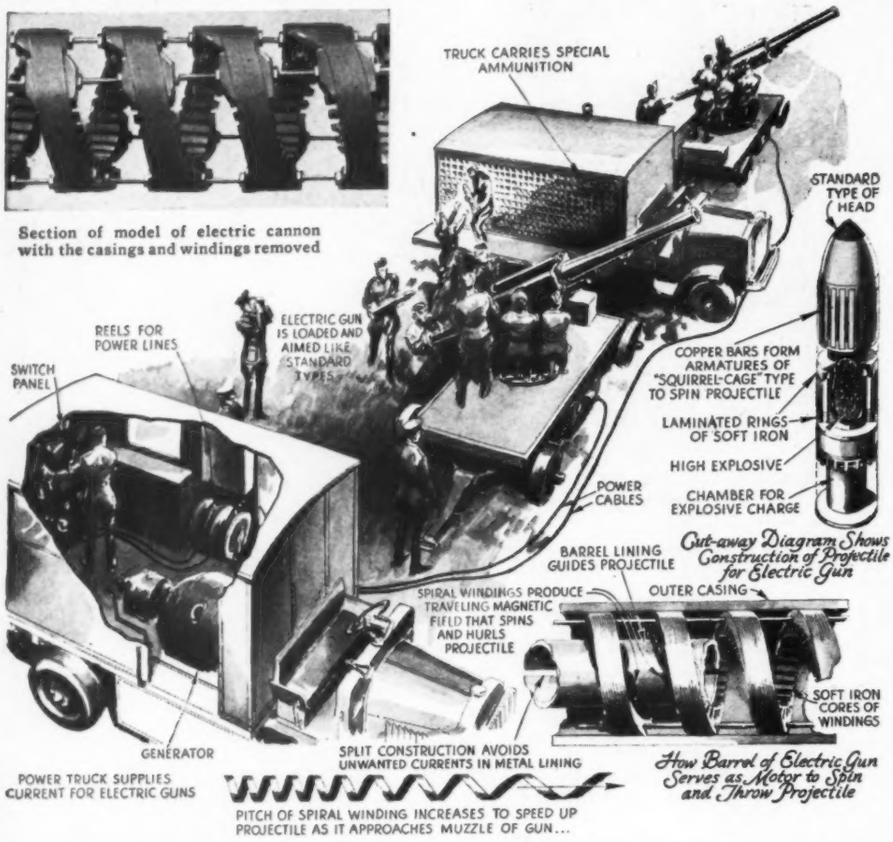
DESIGNED to end the nuisance of loose and wabbly connection plugs for household electric appliances, a new type employs terminals with spring grips. The terminals, doubled over along their own length, are squeezed flat as the plug is inserted, and provide a contact sufficiently firm to withstand accidental jerks on the cord to which the plug is attached. The plug is removed in the usual way, and an elongated finger grip is provided for this purpose.

REALISTIC CALLER FOOLS BULLFROGS

A "FROG CALLER" resembling an oversize harmonica has been constructed by a California frog farmer. When he blows into its mouthpiece, as shown at right, reeds within a resonating chamber produce so close an imitation of the sonorous, bass "jug-o'-rum" of an adult bullfrog that every frog within earshot is reported to answer. First intended merely as a toy, the device has proved useful to the inventor for locating his biggest frogs, and has resulted in the capture of poachers who follow the artificial sounds.

Silent Cannon Hurls Shells by Electricity

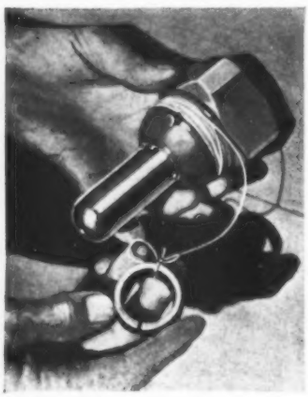
Section of model of electric cannon with the casings and windings removed


TRUCK CARRIES SPECIAL AMMUNITION
STANDARD TYPE OF HEAD
REELS FOR POWER LINES
ELECTRIC GUN IS LOADED AND AIMED LIKE STANDARD TYPES
SWITCH PANEL
COPPER BARS FORM ARMATURES OF "SQUIRREL-CAGE" TYPE TO SPIN PROJECTILE
LAMINATED RINGS OF SOFT IRON
HIGH EXPLOSIVE
POWER CABLES
CHAMBER FOR EXPLOSIVE CHARGE
Cut-away Diagram Shows Construction of Projectile for Electric Gun
BARREL LINING GUIDES PROJECTILE
SPIRAL WINDINGS PRODUCE TRAVELING MAGNETIC FIELD THAT SPINS AND HURLS PROJECTILE
OUTER CASING
SOFT IRON CORES OF WINDINGS
GENERATOR
POWER TRUCK SUPPLIES CURRENT FOR ELECTRIC GUNS
SPLIT CONSTRUCTION AVOIDS UNWANTED CURRENTS IN METAL LINING
How Barrel of Electric Gun Serves as Motor to Spin and Throw Projectile
PITCH OF SPIRAL WINDING INCREASES TO SPEED UP PROJECTILE AS IT APPROACHES MUZZLE OF GUN...

WHEN a switch is thrown, a projectile whizzes silently from an electric cannon proposed by a Trenton, N. J., inventor. No sound or smoke betrays the location of the gun, for it dispenses entirely with powder to fire its shells.

Cannon and projectile together constitute a veritable electric motor. When current is applied to the barrel, field coils become energized and the projectile, with a built-in armature, begins to rotate. By shifting the magnetic field lengthwise along the gun, the projectile simultaneously is given an accelerating forward motion. Thus it obtains both the muzzle velocity and the spin required for accurate flight without recourse to a propelling charge or to rifling in the barrel lining. A crude twenty-foot model of his gun, according to the inventor, hurled a homemade projectile—the rotating part of an electric fan—as far as 1,000 feet.

Practical electric guns, the inventor declares, could be built in any standard size and would have a range equaling or surpassing that of conventional artillery. Mobile generating field equipment would accompany the guns and supply the current, as illustrated in the picture at the left.



SAFETY CIGARETTE HOLDER EXTINGUISHES BUTTS

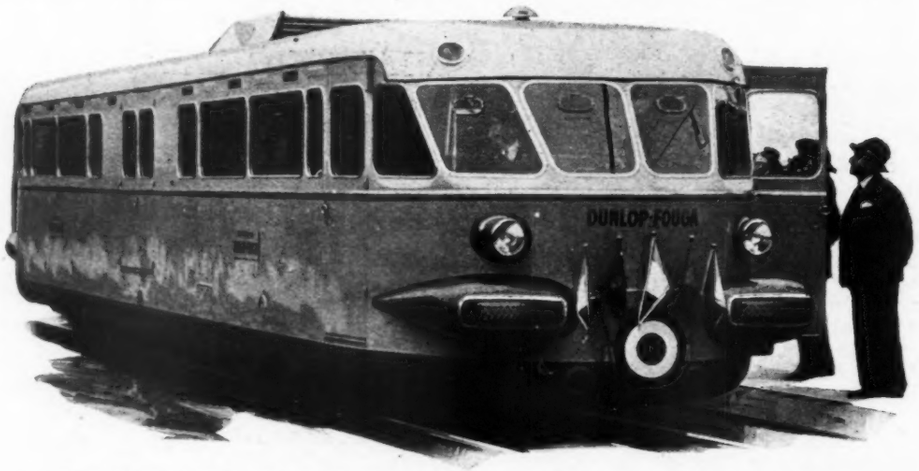
A CIGARETTE goes out of its own accord when it burns down to the beveled tip of a new holder, leaving its stub exposed and making its removal easy. The holder has a projecting collar so that the cigarette may be laid down on a table top without touching and marring the finish.

SPARE TIRES ARE BUFFERS ON RAIL CAR

A PNEUMATIC-TIRED rail car recently placed in service in France makes its spare tires serve a double purpose. Enclosed in compartments at the forward end of the car, with the treads projecting, they act as buffers until needed for replacement. The motor-driven car has a roof-top radiator, made necessary by the fact that flying pebbles from the roadbed would be likely to damage a radiator in the conventional position at the front.

TINY BUOY MARKS GOOD FISHING HOLE

A MINIATURE buoy for sportsmen marks the location of the best fishing holes, and of equipment that has fallen overboard, such as rods, reels, or guns. When it is dropped in the water, a ring-shaped weight sinks and unreels an anchor line from a wooden float. As soon as the weight touches bottom, the float rights itself and a tiny hook projecting from it automatically grasps the anchor line, preventing further unreeling. While the buoy is not intended for river use, its inventor maintains the highest waves will not move it from its position on a lake.



Front of new French rail car, showing spare pneumatic tires doing double duty as buffers

The Man *with the* Net

A ROOMFUL *of women make almost as much noise as Niagara Falls. They produce ninety decibels of sound, while the din of the falls measures only ninety-five.*

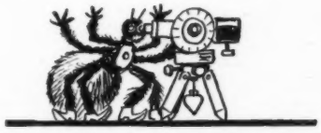
IMPROPER CLOTHING, *according to a recent theory, is to blame for poor posture and inferiority complexes in many children.*

RATTLESNAKE *venom and the white of an egg are formed of exactly the same chemical elements in exactly the same proportions.*

CHICKEN COOPS *are the only buildings in California cities that do not have to be made earthquake-proof, according to legislation enacted in that state.*

CHEWING GUM *was recently discovered to be the cause of hay fever in certain individuals.*

SPIDERS *helped build the Panama Canal. Kept in cages, they provided the fine threads used in the surveying transits of the engineers.*



TEN ELEPHANTS *could stand on the wings and body of a modern airliner without causing it to collapse, weight tests have shown.*

TOP-SHAPED EGGS *are laid on the narrow ledges of the Farallon Islands in the Pacific by the California murre. When disturbed, these eggs spin and roll in small circles and this keeps them from falling off the cliffs.*

ODORLESS ONIONS *were displayed recently in New York City.*

AIRPLANES *are forbidden by law to pass over the White House in Washington, D. C.*

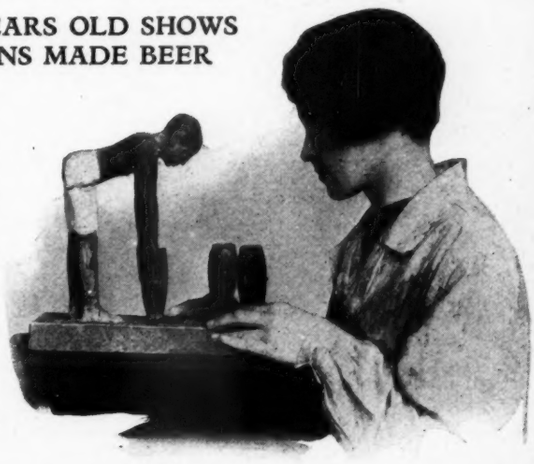
EIGHT HUNDRED *varieties of mistletoe grow in various parts of the world.*

SEAGOING AUTO CROSSES THE CHANNEL

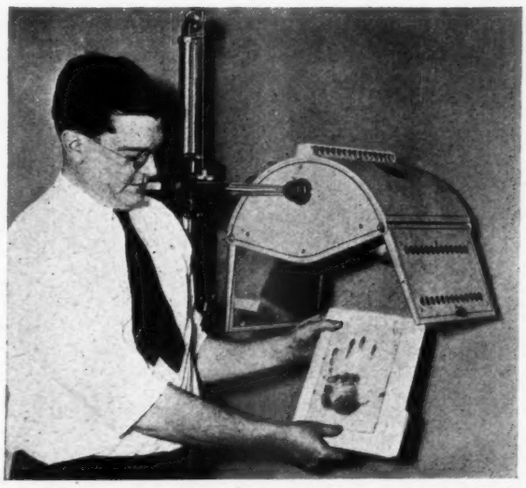
Land-and-water car climbing ashore in England after crossing from France. In oval, side view shows construction

To DEMONSTRATE the seaworthiness of an amphibian automobile of his design, a German inventor recently piloted the strange machine across the English Channel. A small ship accompanied the vehicle as a safety precaution, but no assistance was required. When the driver reached the British shore, after an uneventful crossing from France, he turned the car up the beach and it proceeded along the roads under its own power. In appearance, the car resembles an ordinary racing model.

STATUETTE 4,500 YEARS OLD SHOWS HOW THE EGYPTIANS MADE BEER



EGYPTIANS enjoyed their beer forty-five centuries ago, as evidenced by an ancient carved figure on display at the Buffalo, N. Y., Museum of Science and illustrated at right. The brightly colored wooden statuette depicts a beer maker of the Nile country preparing one of his brewing jars before pouring in the brew. From sediments left in brewing jars of this type that have been unearthed, microscopists have been able to determine the kinds of grains and yeasts that the Egyptians used.



Sun lamp develops chemically treated fingerprints on cloth

FINGERPRINTS ON CLOTH REVEALED

TELLTALE fingerprints left on cloth by criminals are revealed by a method developed by New York City police with the aid of the originator, Dr. E. M. Hudson. When human fingers touch a fabric, Dr. Hudson explains, they leave invisible traces of a substance called "body wax," containing common salt. By applying silver nitrate to the suspected print, the salt deposit is converted to silver chloride, a light-sensitive substance, and exposure to sunlight or artificial light brings out a clear black-and-white image of the print.

Electricity Conquers *the* Arctic

VAST MINERAL WEALTH RECOVERED IN LAPLAND

By HENRY ALBERT PHILLIPS

IF YOU ask the average person to describe Lapland, he will tell you it is an arctic waste inhabited by people who wear furs, drive reindeer, and live in primitive huts. As a matter of fact, many of its houses now are lighted with electricity, express trains speed across it, and, 100 miles above the arctic circle, it has a city of 14,000 white inhabitants. Modern Lapland is a new country—created by electricity.

For 200 years, scientists have known that arctic Lapland is one of the world's richest storehouses of natural wealth. But its treasures lay in a forbidding stronghold guarded by ice and snow, polar darkness, and terrific cold. Now, a dramatic feat of hydroelectric engineering has broken through these barriers, has tapped the vast resources of the country, and is turning the region into a twentieth-century Klondike.

No less than nine rivers rush across this country which forms the northernmost part of Sweden. All flow in a southeasterly direction to pour their torrents into the Gulf of Bothnia. Plunging down mountainsides and over precipices, they have represented, for centuries, power untamed. It was when Sweden became convinced that the water-power resources of Lapland were as valu-

Scenes on the Lapland railway. At the top is the interior of a snowshed which protects the line from avalanches at the point where it crosses the Norwegian frontier. In oval, a motorman at the controls of one of the great electric locomotives. At right, sleeping cars on a siding to serve as hotels for tourists in Lapland

The lights of Kiruna, Lapland's modern city 100 miles above the arctic circle. The photograph was made at midday during the winter season of darkness

able as its mineral deposits that one of the most gigantic enterprises of modern times began.

The earliest step in the immense undertaking, which has seen the transformation of this arctic waste, was the beginning of an extension of the Swedish State Railway. The bold plan was to push the rails 300 miles to the northwest, crossing Lapland and the mountain range separating Sweden and Norway, ending the line at the Norwegian fishing village of Narvik.

By reason of its location on the Gulf Stream, Narvik is an open port the year around, while the nearest Swedish port, Lulea on the Gulf of Bothnia, is ice-bound for six months of every twelve. During the first year after the railway reached Narvik, 800,000 tons of Lapland ore sailed from the port. This was both the limit of mine production and of shipping capacity which could be attained until the plans for complete electrification could be carried out. Without this, the venture could not be made to pay, In the eyes of the man on the street, the whole enterprise still threatened to be the most colossal failure of a generation.

Early in the twentieth century, science had revolutionized the methods of prospecting for ores. Electricity was introduced in prospecting even for nonmagnetic ores. An electric current passed into the ground followed the line of least resistance, and by studying its course it could readily be ascertained which parts of rock and earth conducted the current better than others. It gave a sure indication where ores were to be found. In time, a considerable improvement was made by utilizing the vacuum tube, so well known now in radio. Instead of passing the current directly into the ground, an electromagnetic field was created inductively by passing an alternating current through coils laid on the ground. By means of these improved methods, *(Continued on page 105)*

The power house at Porjus, the nerve center of modernized Lapland. The building on the surface, seen in the upper picture, houses only the control system and quarters for the engineers. The generator room, shown above, is located 160 feet below the ground, where frost cannot penetrate

The National High School Orchestra, picked from the schools of the country, in a public concert

Has Your Town an Amateur

By Earl Chapin May

THE familiar accusation that America listens to music but doesn't produce it, no longer is valid. A wave of interest in amateur orchestras has swept the country. Youthful musicians, from coast to coast, are presenting programs to enthusiastic audiences. High-school and grade-school orchestras numbered 37,000, last year. Summer camps, schools, community clubs —all are taking an active part in the movement. The amateur's day in the orchestra world is here.

The boom in bands, described in the March issue of POPULAR SCIENCE MONTHLY, may be more spectacular than the current activity in orchestras, because of the colorful uniforms and open-air marching. But numerically, and often artistically, the orchestra musicians are superior.

Until a few years ago, virtually all our really good orchestras were strictly professional. Any group of stringed, woodwind, brass, and percussion instruments whose players produce melody and harmony is an orchestra. Amateur groups, ever since the English colonists first came to America, have been *trying* to be orchestras. But rarely have they succeeded. Charitable friends and relatives applauded their efforts, but trained musicians avoided hearing them whenever possible.

Now, all this has changed. Groups of excellent amateurs are doing credit to hundreds of communities. The story of my own home-town orchestra in Rochelle, Ill., will illustrate what has happened in recent years.

At the right, students in a Chicago, Ill., school are learning the scientific principles of sound by building their own instruments. One pupil tests the pitch of an organ pipe while another tunes a homemade xylophone. Below, a special study group at the National Music Camp at Interlochen, Mich., where selected players gather each summer for eight weeks of intensive training

Photo © Spencer & Wyckoff

Symphony Orchestra?

In my youth, our only orchestra consisted of "Mode" Southworth and "Lem" Tilton, farmers who played fiddles spontaneously but crudely; "Clinch" Gardner, our well-known auctioneer, who did his best with the horsehair bow and catgut strings of a bass viol or "bull fiddle;" "Dutch" Unger, our popular undertaker, who managed to extract tones from a clarinet; Willis Calkins, son of our able tinsmith, who did sensational although technically erroneous stuff on the drums—and myself as the hopeful, but not expert, boy cornetist.

Sometimes this self-taught ensemble was varied by the presence of Frank Hamilton, our house painter, as the entire and tireless "violin section," while Johnny Bain, Ogle County's best corn grower, twanged away on an Irish harp. *(Continued on page 101)*

A small orchestra at Interlochen. In addition to playing with the National High School Orchestra, the young musicians attending the National Music Camp are given the opportunity to perform in smaller groups. Each student also is given special coaching in his own particular instrument

Piano students in a school music class learn the mysteries of the keyboard on dummy instruments. Each pupil is furnished with a replica of the standard keyboard, on which he "plays." The teacher leads the class on a real instrument. This method introduces the spirit of group effort and competition into piano study

CLASPS HOLD FISH ON STRINGING LINE

A NEW accessory for fishermen, to keep fish alive and tethered during a day's outing, consists of a cord with clasps like safety pins, to which fish are clipped as soon as caught. One end of the string is provided with a spike for anchoring to the gunwale of the boat and the other, equipped with a ring to keep the clasps from sliding off, is trailed overboard. The line also can be used in fishing from the shore.

TREES ARE PARASITES

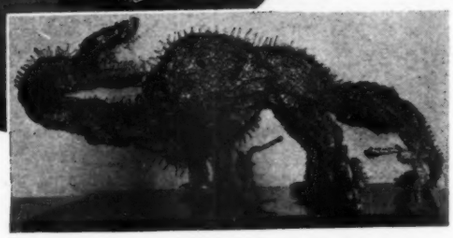
SCOTCH pine has been added to the list of trees known at times to draw nutriment through root connections with neighbor trees, rather than from the soil. Others include fir, spruce, larch, and white pine.

MODELS STATUES IN TWISTED WIRE

MAKING grotesque figures of men and animals out of twisted wire is the odd hobby of Berthold Ordner, blind Viennese sculptor. By the use of iron, brass, and copper wire he imparts colorful effects to his caricatures, of which two are shown in the accompanying illustrations. One depicts a toreador giving the death blow to a bull; the other is an amusing representation of the fabulous Loch Ness monster of Scotland.

Berthold Ordner, blind Viennese sculptor, uses iron, brass, and copper wires to fashion fanciful caricatures

The toreador and bull in this lifelike group are made of twisted wires of many colors



At the right is the fabulous Loch Ness monster as modeled in wire by Ordner

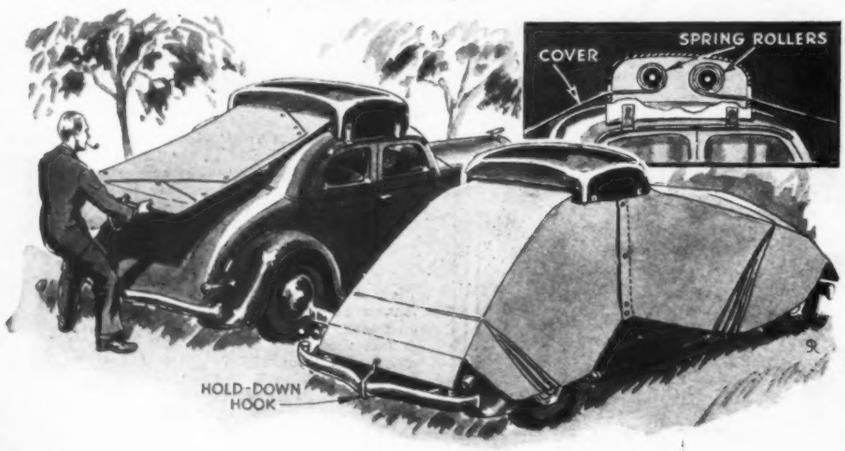
JOINTS KEEP FENCE FROM BUCKLING

Joint permits expansion in metal fence

A NEW expansion joint for metal fence railings, employing a spring coupling, prevents them from moving out of alignment from temperature changes. Tests show that 100 lineal feet of fencing will expand or contract as much as five eighths of an inch with a temperature variation of 100 degrees. The new coupling permits this contraction or expansion without buckling. Similar joints have long been used in the design of large structures, but this small-scale application of the idea is considered an innovation.

BURNING COAL MINE SUPPLIES GAS

TO SAVE the cost of transporting coal from mine to consumer, the scheme of burning it underground and piping the resulting coal gas hundreds of miles to cities has often been proposed. Now word comes from Russia that the idea has been put into practice on an experimental scale. After tunneling through a subterranean coal vein near Lisichansk, engineers deliberately set the vein afire, capped the shafts, and installed a piping system, as shown at the right, to collect the gas. Soon the burning coal pocket became a giant underground retort yielding quantities of gas. The first samples proved of low heating value, but as the underground fire grew in intensity the quality of gas rapidly improved.



PORTABLE GARAGE FOLDS INTO ROOF OF CAR

A CAR that carries its garage on its back is the invention of a Camden, Ark., designer. When the machine is left outdoors, waterproof curtains, wound like window shades on spring rollers within a compartment at the top, may be withdrawn to provide protection. Hooks at the end of the twin curtains engage the car's front and rear bumpers to hold the covering in place. Side flaps fold down and are made fast to the running boards, enclosing the car completely. It is but a moment's work to detach the covers and slide them out of sight in the roof compartment, as shown in the illustration at the left.

CHILDREN'S TRICYCLE IS AMPHIBIAN

SIDEWALKS and ponds, roads and lakes, may be navigated with equal ease by an amphibian tricycle just introduced for children. Foot pedals turn the rear wheels, which serve as paddle wheels in the water, while the front wheel forms a rudder. Five-foot pontoons at each side hang clear of the ground when the odd vehicle takes to the land, where it runs on rubber tires.

The tricycle takes to the water. Rear wheels are paddles

On land, this novel craft for children travels on three rubber-tired wheels

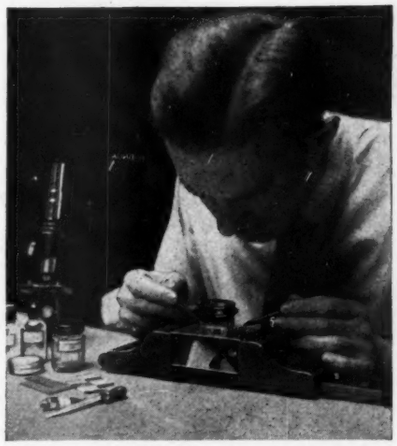
ODD FILM DRIER SPEEDS AERIAL PHOTOGRAPHY

SHAPED like a bass drum, a film drier perfected by a Philadelphia, Pa., aviator is a portable aid to aerial photography. Film passes around the inside surface of wooden rollers spaced along the rim. It is dried by air from a suction fan at the side in twenty-five to forty minutes. After drying, the film is automatically wound on a take-off spool. The photograph above shows the drier being loaded with film from the spool used in developing.

New communication system allows officer on bridge to speak with passengers or crew in any part of ship. At left, a loudspeaker in a cabin, showing clamp which grounds set to the vessel's hull

SHIPS MADE SAFER BY LOUDSPEAKERS

THROUGH a loudspeaker system just installed on the S. S. *Colombia* and the S. S. *Pastores* of the Colombian Line, the captain may address passengers or crew to make announcements or to issue commands in an emergency at sea. Thus passengers might be directed to lifeboats and orders given to lower the boats away, with a minimum of confusion. When an officer speaks into a microphone on the bridge, switching apparatus directs his voice to loudspeakers in the staterooms, in the crew's quarters, or on the decks. Officers in the engine room and elsewhere may reply by talking into the loudspeakers. For two-way communication, the system depends on wires in armored cable. If fire should destroy these wires, commands still could be transmitted from the bridge to all parts of the ship by the principle of "guided radio," using the metal hull of the vessel.



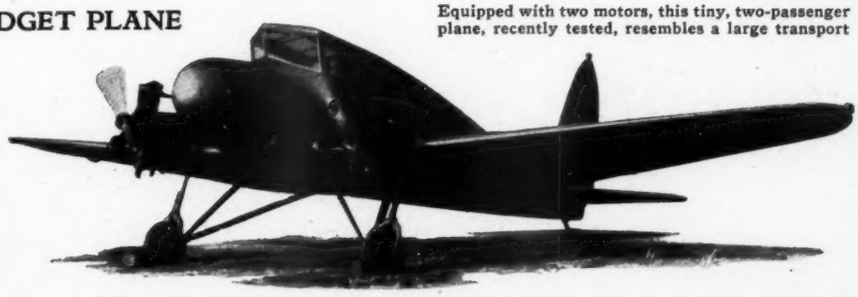
DISSECTING MICROSCOPE SIMPLIFIES SLIDE MAKING

PREPARING microscope slides from specimens of insects and plants is made easy by a new dissecting microscope, shown in use above. A needle and scalpel may be manipulated beneath a removable lens which magnifies the work seven and a half times, and which is mounted on a post in such a way that it may be swung across the field. Coarse and fine focusing adjustments are provided. A mirror illuminates the wide glass stage. A handy instrument drawer is mounted in the base of the instrument.

TWIN MOTORS PROPEL MIDGET PLANE

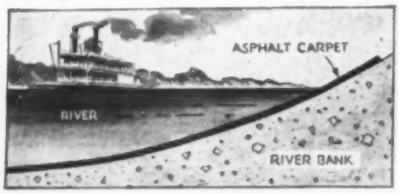
A BABY twin-motored plane, believed to be the smallest flying today, recently passed its tests at Los Angeles, Calif. The new machine has a wing span of less than thirty-five feet and an overall length of scarcely more than twenty feet. The two engines provide a wide margin of safety, either being able to propel the craft alone. The new plane seats two and is reported to fly eighteen miles on a gallon of fuel.

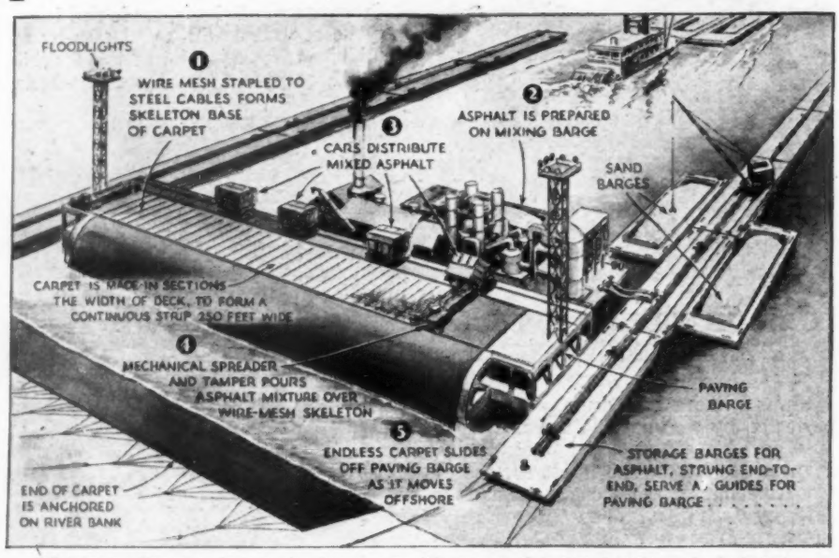
Equipped with two motors, this tiny, two-passenger plane, recently tested, resembles a large transport



Asphalt Carpet To Pave River Banks

PAVING the banks of the Mississippi River with flexible carpets of asphalt is the latest means adopted by U. S. Army engineers to check erosion and control floods, after mats formed by linking concrete slabs proved inadequate. In the new plan, a paving barge manufactures a carpet of reënforced asphalt as it slowly moves away from the shore. The end of the carpet is anchored to the river bank and the endless mat sinks to the bottom as the ship progresses away from shore, forming an indestructible protection against the scouring effect of racing currents. Auxiliary barges, anchored in two lines at right angles to the shore, guide the paving barge and supply it with materials.




FLOODLIGHTS
1 WIRE MESH STAPLED TO STEEL CABLES FORMS SKELETON BASE OF CARPET
2 ASPHALT IS PREPARED ON MIXING BARGE
3 CARS DISTRIBUTE MIXED ASPHALT
SAND BARGES
CARPET IS MADE IN SECTIONS THE WIDTH OF DECK, TO FORM A CONTINUOUS STRIP 250 FEET WIDE
4 MECHANICAL SPREADER AND TAMPER POURS ASPHALT MIXTURE OVER WIRE-MESH SKELETON
PAVING BARGE
5 ENDLESS CARPET SLIDES OFF PAVING BARGE AS IT MOVES OFFSHORE
STORAGE BARGES FOR ASPHALT, STRUNG END-TO-END, SERVE AS GUIDES FOR PAVING BARGE
END OF CARPET IS ANCHORED ON RIVER BANK

Manufactured on a curious paving barge, a flexible carpet of asphalt is laid on the bed of the river. Cross section at left shows how the carpet acts to prevent erosion of banks by currents

ROBOT CHEMIST ANALYZES POISON GAS

This compact kit identifies any type of poison gas present in the atmosphere

NOT only does a robot chemist, recently demonstrated before French military officials, warn of the approach of enemy poison gas, but it detects the individual type of toxic vapor employed. Reactions within the flasks and tubes of the cabinet enable an observer to identify the poison in time for those in the vicinity to don gas masks employing the proper neutralizing chemicals.

WATER WHEEL ANIMATES SCARECROW

Lifelike movements are imparted to the scarecrow by the water wheel and pulleys

FAR more effective in scaring birds away than a stationary figure is a scarecrow that waves its arms, devised by an Oregon gardener. A water wheel in a near-by stream animates the effigy automatically by means of a rope and pulleys, giving the realistic effect shown in the illustration.

Hose attachment contains chemical cartridge which dissolves, forming an insecticide spray

ATTACHMENT MAKES HOSE AN INSECTICIDE SPRAY

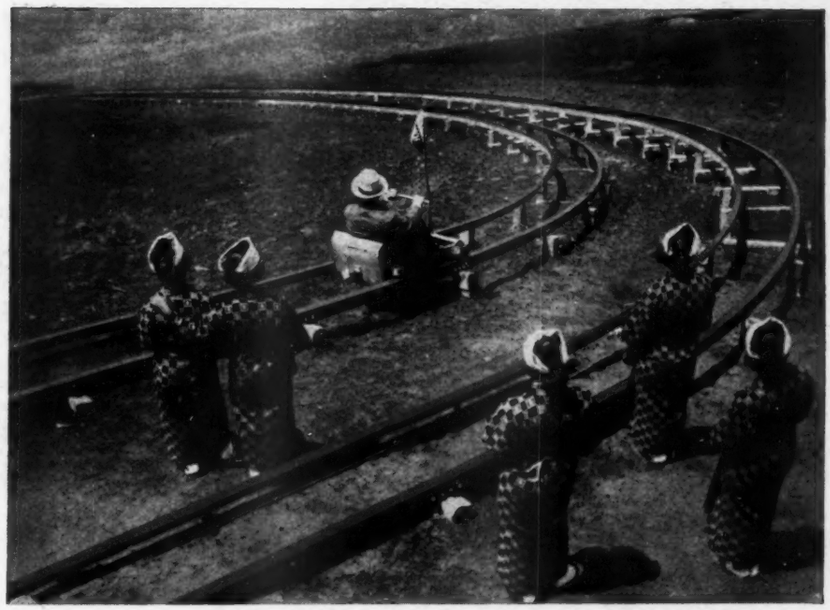
APPLYING insecticide with a garden hose is made easy by a new attachment, employing chemical cartridges that dissolve in the water. One cartridge is sufficient for one to two hours of spraying. A hand valve regulates the spray, and a curved nozzle directs it.

HEARTBEATS AMPLIFIED

AS MANY as 100 doctors and medical students may listen at once to a patient's heartbeats, with a new electrical stethoscope and amplifier developed in a Montreal, Canada, hospital to aid diagnosis.

TRAVELERS RIDE ROLLER COASTER DOWN VOLCANO

A RIDE upon a scenic railway in a natural setting awaits visitors to Oshima Island, Japan, where tracks have been laid from the summit to the foot of the celebrated volcano Mihara-yama. Seated in individual cars, riders round hairpin turns and drop in breath-taking dips on the way to the bottom of the 3,000-foot course, which is believed to have no counterpart in the world. The coaster is actually a means of transportation down the volcano. Thousands of Japanese tourists climb or ride to the volcano's fiery crater, which has become a Mecca for pleasure-seekers, and many ride this thriller downward.



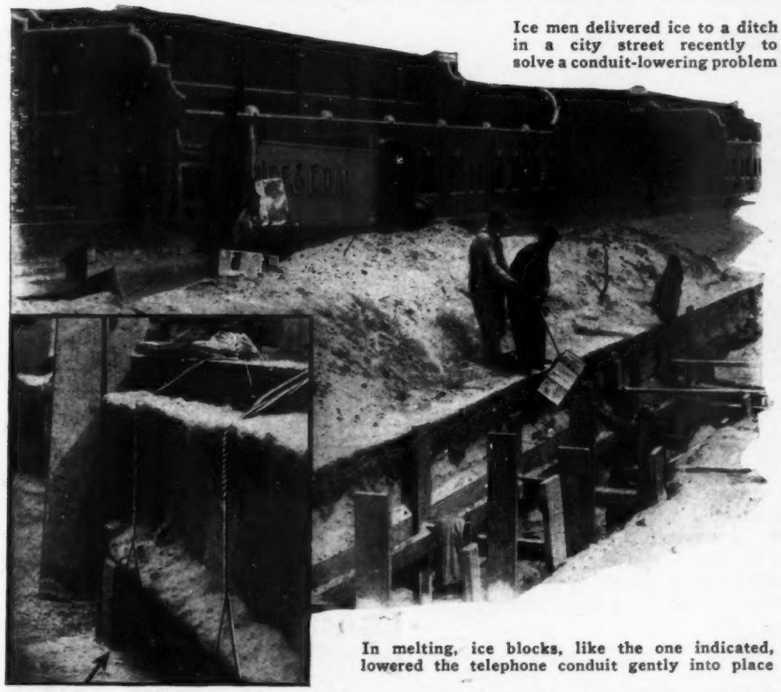
In an individual car, this Japanese starts a thrilling coaster ride down the volcano Mihara-yama

AIRSHIP LINE FOR RUSSIA

AN INLAND dirigible line in Soviet Russia, scheduled to begin operation in September, will link Moscow with the city of Sverdlovsk, new industrial capital of the Urals. Airships will cover the 1,000-mile distance, nonstop, in eighteen to twenty hours, or about two and a half times as swiftly as the fastest trains.

ICE BLOCKS LOWER TELEPHONE CABLE

Ice men delivered ice to a ditch in a city street recently to solve a conduit-lowering problem

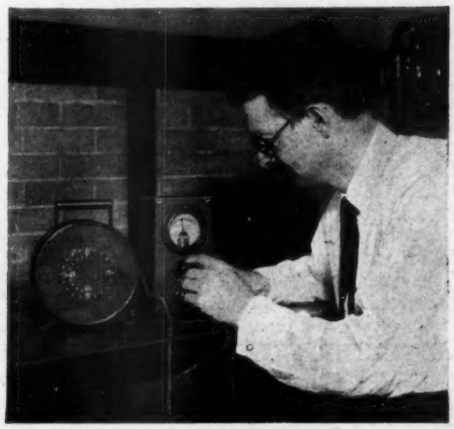


In melting, ice blocks, like the one indicated, lowered the telephone conduit gently into place

TO ALLOW for a projected change in street level in Brooklyn, N. Y., engineers recently were faced with the ticklish task of lowering a 3,200-foot length of telephone conduit thirty inches without breaking the conduit or the maze of cables it held. The problem was solved by shoring it up on 100-pound blocks of ice and digging the earth from under the conduit. Slowly melting, the ice blocks gently lowered the conduit and this operation was repeated at intervals until the desired level was reached.

ABSORBS MACHINE'S VIBRATIONS

TO KEEP machines from spreading their vibrations, a shock-absorbing base sandwiches a strip of deadening felt between two metal bars of channel shape. Overhang of the upper, wider bar, which is bolted to the machine, prevents oil from dripping upon the felt and impairing its effectiveness. The narrow lower bar rests freely upon the floor without need for fastening.



DUMMY RADIUM DIALS GAUGE RADIANCE OF REAL ONES

IMITATION radium dials, devised by U. S. Bureau of Standards experts, aid inspectors in grading the brightness of real ones destined for watches and airplane instruments. Numbers corresponding to those of the dial to be tested are cut from an opaque stencil. This is then attached to a window illuminated by a flashlight bulb. By varying the current until the brightness of the synthetic dial and the genuine one match, and measuring the current, as illustrated above, the sample under test may readily be graded for visibility.

RUBBER-PRONGED RAKE IS NO HAZARD TO GARDENER

STEPPING on the upturned teeth of a new rake incurs no risk of a head injury, for the teeth are made of rubber and bend beneath the foot. According to the manufacturer, the teeth are pliable enough to avoid damage to plant roots but are springy and resistant enough to pick up effectively grass cuttings and leaves.

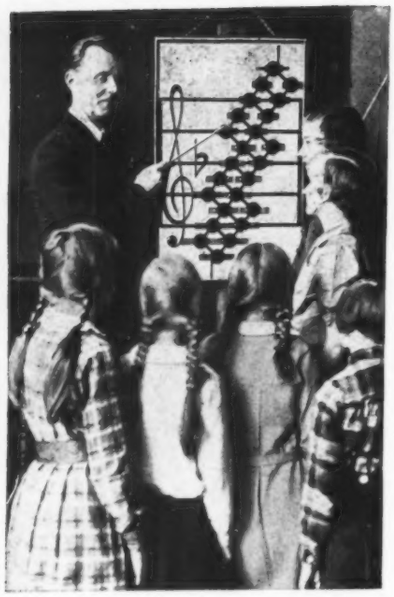


CHART SOUNDS NOTES TO TEACH MUSICAL SCALE

To AID children in learning the musical scale as written on a staff, a German organist has designed the novel instruction chart shown above. Each of the printed notes contains a tuned metal sounding bar, and when the note is struck with a pointer it sounds its own pitch, definitely associating the sound with the position of the note on the staff. Semitones, arranged in separate rows, are similarly sounded. The device is soon to be introduced as an educational aid in Berlin schools.

SPEAKER GUIDES PLANES

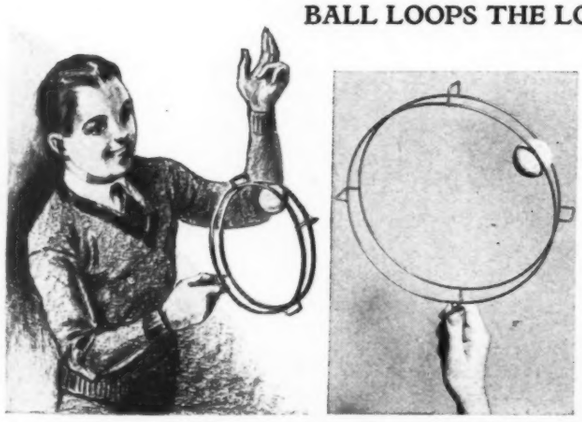
AIRPLANES landing aboard a U. S. Navy carrier were directed by a giant loudspeaker in recent tests. The device makes the human voice carry for a mile.

SLEEPING COMPARTMENT IS CARRIED ON CAR ROOF

BY ADDING a second-story bedroom to his car, an Inglewood, Calif., doctor has equipped it for long-distance camping trips. A light, rigid framework supporting the sleeping compartment and a ground-level kitchenette is speedily attached to the frame and bumper of the car, and may be as readily removed for storage in the garage until the next trip. The top of the flat, dust-proof compartment housing the bed lifts at one end to form a lean-to shelter, with sides that may be opened or closed. Room also is provided for fishing tackle or guns.

Dust-proof compartment on top of car forms lean-to shelter at night

BALL LOOPS THE LOOP IN NEW TOY

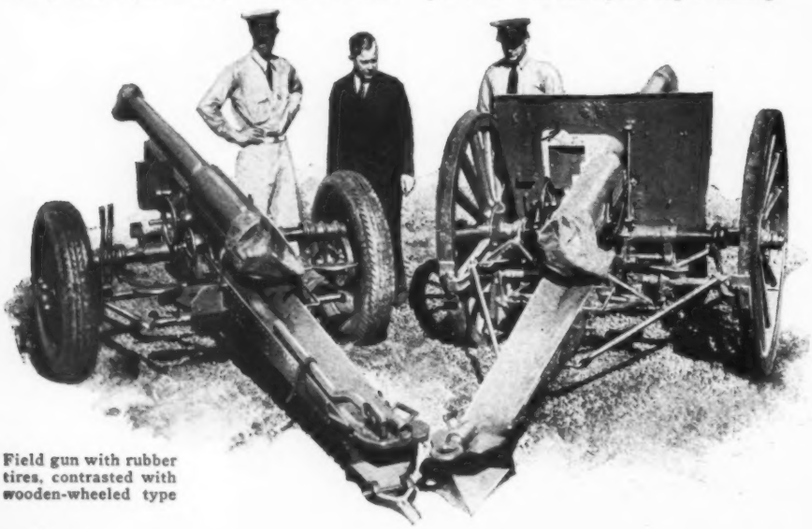


When the handle is manipulated, the ball does surprising tricks

QUICKNESS of eye and muscle are called for by a new toy just introduced to the public. It consists of two parallel loops of wire and a handle by which the user causes a soft rubber ball to roll along the circular track. With comparatively little practice, according to the maker, anyone can perform a variety of tricks, making the ball loop the loop and execute many seemingly difficult evolutions.

FIELD GUNS ROLL ON RUBBER TIRES

SO THAT fast cars can whirl its field guns to a scene of action at a mile-a-minute pace, the U. S. Army is modernizing the horse-drawn "75's" of the last war with new carriages employing rubber tires and puncture-proof tubes. Wooden wheels formerly used, experts point out, have been doomed by the increasing speed of military maneuvers. Individual wheel brakes on the new-style carriage permit one wheel to be locked while the gun pivots on the other, for rapid aiming.



Field gun with rubber tires, contrasted with wooden-wheeled type

RENEWABLE BLADE KEEPS KNIFE SHARP

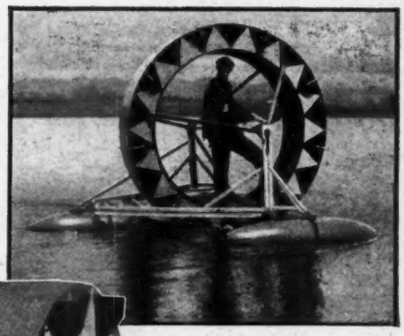
REPLACEABLE blades of razor sharpness assure a keen edge for a handy home and office knife. When a blade becomes dull, it is released by pressing a lever and a new one is inserted. The blades are designed especially for use in the tool, distinguishing it from devices that aim to adapt ordinary safety-razor blades for cutting purposes. The illustrations show the new knife and a close-up of the blade that it uses.

NEW AIR-DRIVEN WRENCH HAMMERS BALKY NUTS

ALMOST human in its action, a new pneumatic tool known as an impact wrench removes "frozen" nuts, and swiftly drives new ones home. In applying a nut, the tool spins it into place at 700 revolutions a minute and then delivers a series of torsional or twisting blows that lock the nut securely. The process is reversed in withdrawing a balky nut. Whenever the tool meets resistance, the intermittent twisting action automatically comes into play, a cylindrical block of rubber having stored energy for each powerful blow of the rotary hammer.

SQUIRREL-CAGE WHEEL RUNS WATER CRAFT

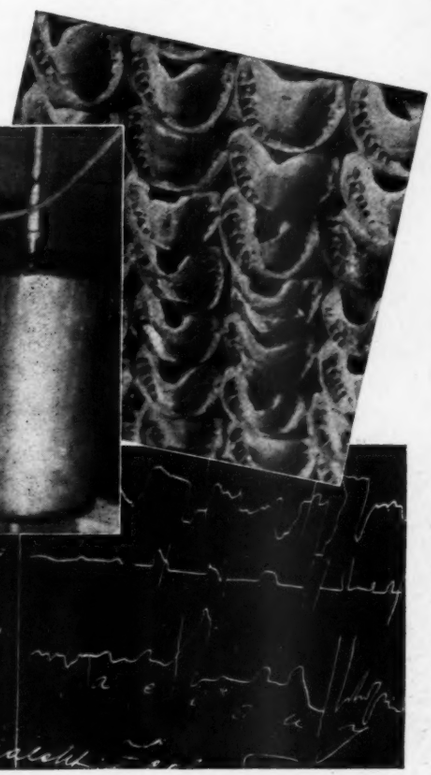
ONE of the oddest of water craft enables its designer to navigate a river near his home. By walking within a central paddle wheel, in treadmill fashion, he revolves the wheel around him and propels the queer boat at a lively pace. Three floats support the wheel and the frame on which it turns, in such a way that paddles set on the rim of the wheel dip into the water at the lowest point in their revolution. The boat may be steered to left or right, and driven forward or backward. It can carry one or two persons.



A large paddle wheel, turned by the user walking inside it, drives this novel water craft

TESTS SHOW HOW TEETH AFFECT VOICE

How false teeth will affect the voices of their users was the subject of an unusual study recently undertaken by Dutch research workers. In the course of the experiments, hundreds of subjects made records of their voices by uttering vowel sounds and selected sentences, while a recording device registered graphically their differences in intonation. Wax impressions were also made showing the conformation of the teeth and other parts of the mouth. The studies revealed that a slight difference in the pattern of the teeth may produce a marked change in voice quality. The graphic recordings emphasized the care required in designing artificial teeth in such a way as to avoid causing an undesirable alteration in the natural voice intonations of the wearer.



Subject utters vowel sounds into a machine which makes a graphic record of speech characteristics

At the right is a record of intonations made to determine the probable effect of false teeth on the voice. Above it are seen wax impressions of oral cavities

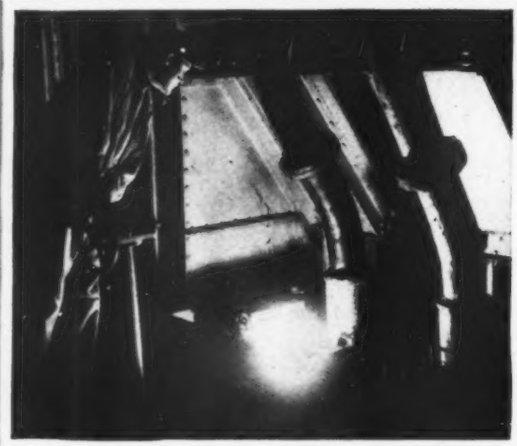
INSTRUMENT GIVES AREAS OF IRREGULAR FIGURES

MEASURING the area of an irregular figure on a map or blueprint is made easy for engineers and surveyors by a compact new instrument. Its transparent dial, bearing a series of concentric circles, is laid over the figure and fixed in place with a push pin. A reference mark is made opposite a zero point on the graduated rim of the dial. The dial is then turned an amount corresponding to the length of the first circular arc that crosses the figure. This is repeated in turn for each of the remaining circles crossing the figure, whose area is directly indicated by the final reading at the rim of the dial.

While a Great City Sleeps

Faithful Workers Guard Its Comfort and Safety

The police force of a metropolis must be on the job twenty-four hours of the day. Below, officers in a patrol car receive orders by short-wave radio to go at once to the scene of a reported crime



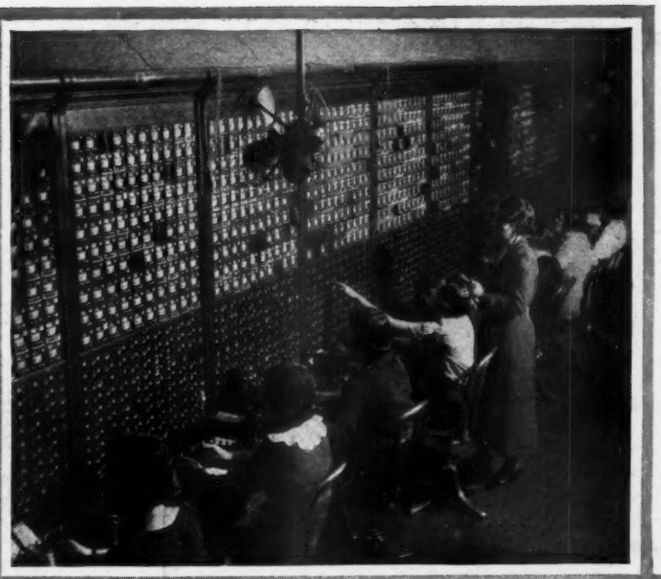
In the maternity ward of a large hospital, new-born babies have constant care. Each occupies a crib marked for identification

An army of scrubwomen, like those in the picture below, invades the stores and offices of the city when the day workers leave

An engineer in a plant which supplies steam to a large number of apartment, hotel, and office buildings. He is controlling the flow of ground coal into the furnace

Supplying the city with food is an important task. At the right is a scene in one of the wholesale produce markets where retailers purchase stocks for the next day

THE real "night life" of a large city is not to be found in its night clubs, but among the thousands who work from dusk to dawn



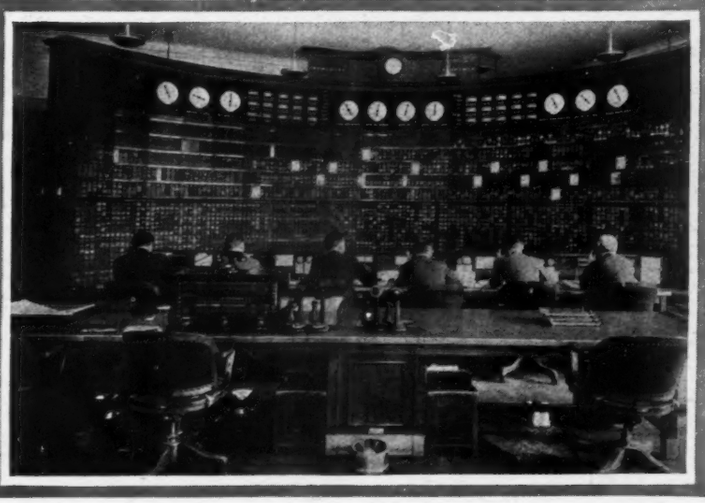
Night watchmen, on their tours of inspection, report their progress to central offices by means of wall boxes like the one pictured below

Special pumping stations are ready, day and night, to supply water at high pressure for fire fighting. The picture above shows an engineer at one of the huge pressure valves

On the switchboard of a burglar-alarm agency, flashing signals give warning when protected safes or doors are disturbed. Guard stations are then notified

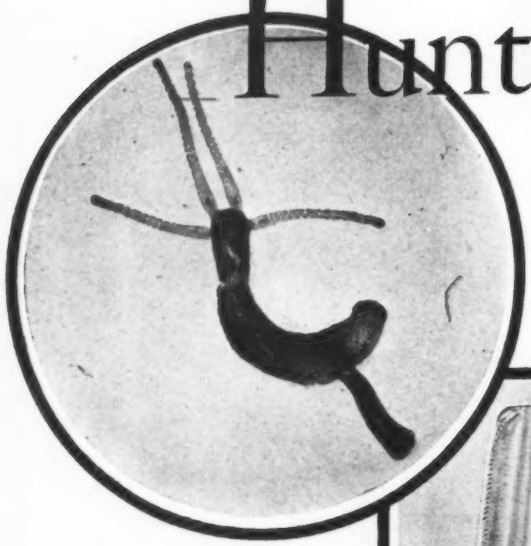
Best known of all night workers is the milkman. With his faithful horse, he leaves the milk depot long before daybreak in order to complete his rounds

Below is the pilot board of a large electric power plant. The six men are watching instruments which record the flow of current. They adjust the supply of electricity to the changing demand

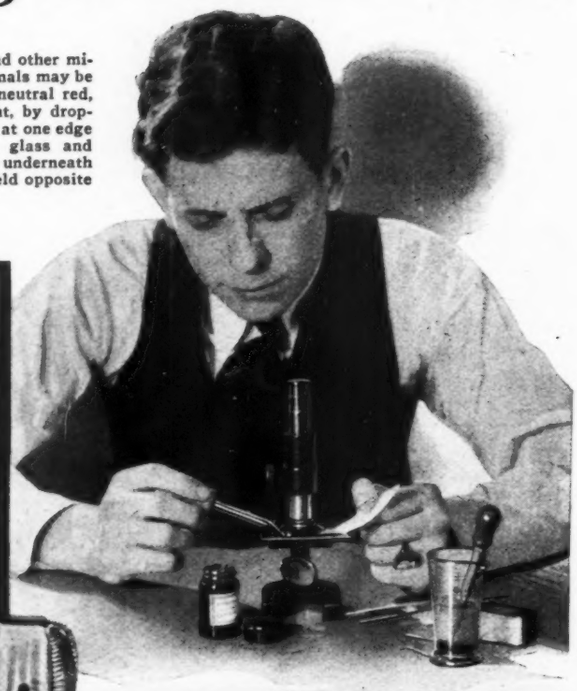


To guard the safety of subway riders, trackwalkers patrol miles of underground railways every night, closely scrutinizing rails, switches, signals, and other equipment for flaws that might cause wrecks

Hunting STRANGE



A hydra photographed under the microscope. The projection at the lower end is a bud which later will detach itself to form a separate animalcule



Protozoans and other microscopic animals may be stained with neutral red, as at the right, by dropping the stain at one edge of the cover glass and making it flow underneath to a blotter held opposite

Silica diatom skeletons, like the pair shown above, often are found in pond water in which microscopic animals are being trapped. These plant forms have great beauty. At the right is a living diatom which was caught on an albumen-coated slide during the preparation of specimens of protozoans and the allied organisms with which they live

A network of cotton fiber, placed on the slide to restrict the movements of tiny animals, is magnified at right

A NET TO HOLD TINY ANIMALS

To keep specimens from being washed off the slide when it is irrigated, or to hold them still for examination, a tuft of cotton is placed on the slide

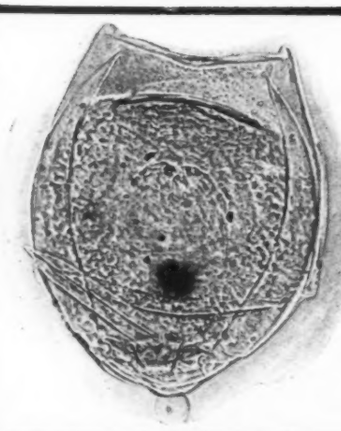
By
MORTON C. WALLING

THE difference between the microscopist who attempts to "bring 'em back alive," and the hunter who stalks an Asiatic tiger with similar intentions, is mainly one of the size of the game. Capturing microscopic organisms and making them behave can be every bit as exciting as the subduing of larger animals—and it is much safer.

There are good reasons why almost every amateur turns to a drop of stagnant water for his first thrills in microscopy—and returns to it time and again as long as he pursues his hobby. In such a drop is a world teeming with life, a world peopled by a seemingly endless variety of strange little creatures which are always ready to put on a show. These interesting performers usually are not difficult to find, for they abound in back-yard lily ponds, roadside ditches, fish aquariums, and wherever else there is water that stands undisturbed for considerable lengths of time.

The creatures to be found in such places have been described in earlier articles of this series. Doubtless, every microscopist who has been engaged in his hobby more than a few hours, already has made the acquaintance of many of them. He has discovered that it is not always an easy matter to make them behave while he studies them. In fact, even to find a particular specimen may be surprisingly difficult; and when, at last, it is captured, it may add insult to injury by galloping all over the slide, making it next to impossible to see details of its anatomy. A few ways of making protozoans and other microscopic creatures behave will be described.

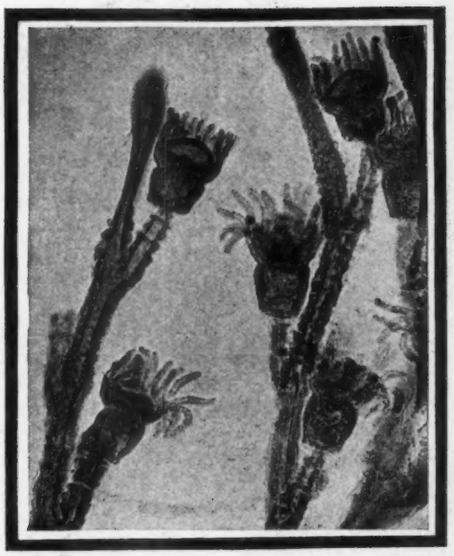
For capturing specimens in lily pools



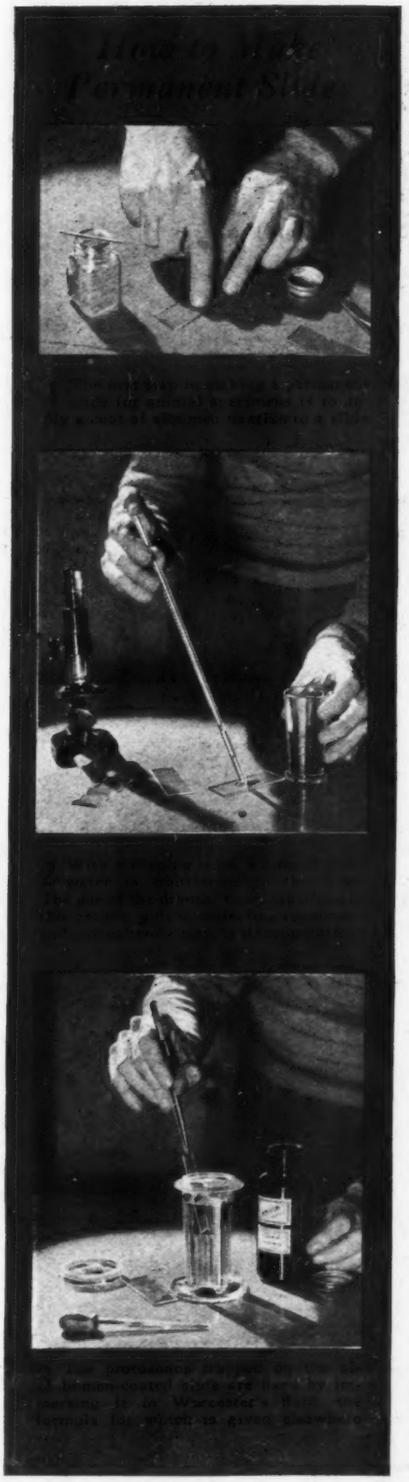
What Is It?

HERE is a chance to try your eye at a little microscope detective work. The specimen shown in the photomicrograph was found in a drop of sediment from a back-yard lily pool. Do you recognize anything familiar about its general appearance? Does it remind you of any microscopic animal you have seen? If you have any ideas as to its identity, jot them down and mail to the Microscope Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

CREATURES *with your* Microscope



Although it looks like a plant, the strange specimen pictured above is an obelia, a colonial organism that lives in the sea. It was stained to show its structure



and stagnant ditches, you need nothing more than a piece of glass tubing a foot long and a few one- or two-ounce bottles with tightly fitting corks. The collecting bottles are to be filled about three fourths full of water and the rest of the way with the sediment that forms a layer over the surface of the pond bottom. Hold a finger over one end of the tube, and lower it into the water until the other end touches the sediment layer. Lift the finger, and the water will rush into the tube, carrying some of the sediment with it. Replace the finger, lift the tube out, and transfer its burden of water and sediment to a bottle. Use the same method to transfer specimens from bottle to slide.

Add a quantity of dry hay to a jar of water and let it stand for two or three days in a well-lighted place, but not in direct sunlight. At the end of that time, it will contain a surprising number of microscopic specimens. Water that has been standing in a container for a day or two is better than water taken directly from a faucet, because it is free from excess dissolved oxygen and other gases. Lettuce leaves also can be used to make an infusion that will provide other types of little animals.

An aquarium, especially one that contains both fish and growing plants, in which the water is not changed often, will yield a normally invisible menagerie that will keep you busy for hours. The waste matter that collects on the bottom, frequently is alive with rotifers, little creatures whose activity and complexity of structure makes them interesting microscopic subjects. With the rotifers may be found little wormlike animals or nematodes, close relatives of vinegar eels. Hydras, many-armed animals just barely visible to the naked eye, sometimes can be captured on the walls of an aquarium nearest the light.

The usual way of preparing these organisms for observation is to transfer them to a clean glass slide in a drop of the same water in which they are growing, and then lower a clean cover glass over the drop to flatten it out in a thin layer. If you are not careful, the water will evaporate before you know it, and your zoo will shut up shop in a hurry. It takes scarcely a half hour for all the water to disappear from beneath a cover glass under average conditions, though the only surface in contact with the air is a thin line around the edges of the cover!

Every fifteen minutes or so, add water to that on the slide. Simply place, with the aid of a medicine dropper or pipette, a little water on the slide at one edge of the cover glass, where it will touch the edge but will not flow over the top. The water will be drawn between slide and glass by capillary attraction.

If you must leave the preparation for longer than a quarter hour, there is a way of preventing loss of your specimens. Simply apply a ribbon of petroleum jelly along the slide edges, so that it forms a seal that prevents the air from reaching the water. Some kind of "grease gun" will have to be used for this. Perhaps you can obtain an empty collapsible tube of the type commonly used for applying salve to the eyes. Such tubes have long, slender nozzles. Fill the tube by removing the clip at the end, and, if necessary, flatten the nozzle slightly to make the ribbon thin and wide enough. Another way of making a petroleum-jelly gun is to fit a fine-tipped medicine-dropper tube with a little plunger that can be pushed forward to expel the jelly. In filling such a gun, do not include any more air than is necessary.

To study a lively paramecium, rotifer, or microscopic worm while it is cruising about beneath the cover glass, is a matter of juggling more than anything else. It is a never-ending marvel that there is enough space beneath the cover glass, in a single drop of water, for so much activity to take place. But, of course, you are magnifying everything perhaps 500 times, including the cruising space of the creatures.

MANY times it is desirable to slow down the activities of the specimens. There are several ways of doing this. You can let the water evaporate until the cover glass, drawn towards the slide by the surface tension of the water, presses the specimens so tightly that they cannot move with their usual agility, yet not forcibly enough to crush them. The disadvantage of this stunt is that the time interval during which observations can be made before the creatures are smashed completely, or die from lack of water or oxygen, is not very great. There also is some distortion as a result of the pressure.

Some microscopists mix gelatin with the water, to *(Continued on page 92)*

NEW APPLIANCES FOR THE

Household

A Page of Timely Suggestions For Lightening the Homemaker's Tasks

AN ALL-PURPOSE DUST MASK

Equipped with a transparent window, the dust mask above completely envelops the face. A draw string makes it adjustable to size. The cloth is washable

ROUND, PORTABLE ELECTRIC RANGE

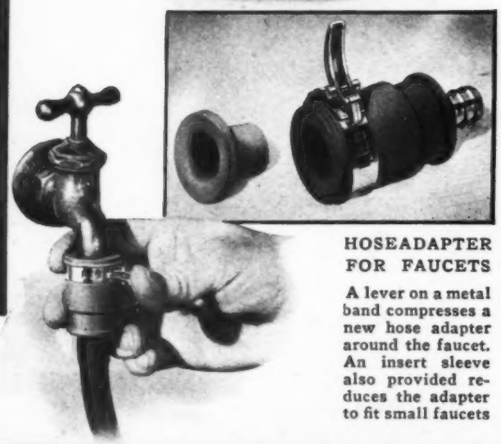
The unusual electric range below is mounted on casters and can be moved to any desired location. An encircling rail near the top facilitates handling. Its round shape is another feature of convenience. In the center is an electric lamp

CABINET WITH REVOLVING SHELVES

A built-in cabinet below a new-type sink has cylindrical shelves instead of drawers. The shelves turn on a vertical axis, bringing the needed item to the front. Curved sliding doors enclose the shelves

INDIVIDUAL TOWEL HANGERS

The capacity of a towel rod can be increased by the use of the detachable wire clamps illustrated above. Sliding freely on the bar, each holds a towel

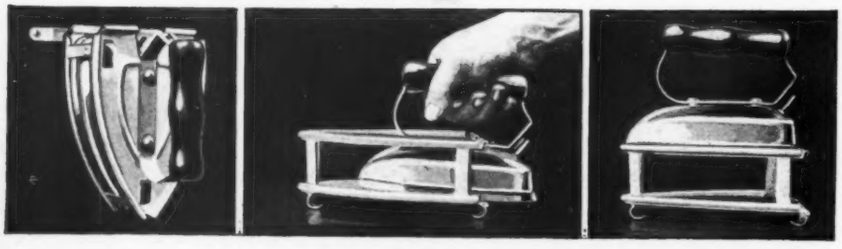


HOSEADAPTER FOR FAUCETS

A lever on a metal band compresses a new hose adapter around the faucet. An insert sleeve also provided reduces the adapter to fit small faucets

LAMP SWITCHES ON OR OFF BY TOUCH

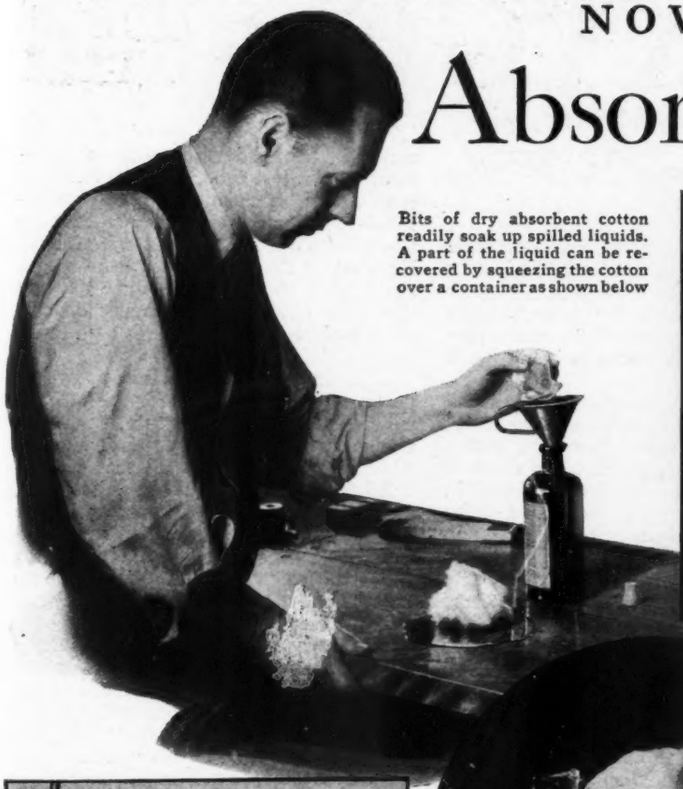
Pressure on the base or column lights the latest in lamps. Because no groping for a switch is necessary, it is an ideal bedside lamp. Absence of the external switch also enhances its appearance



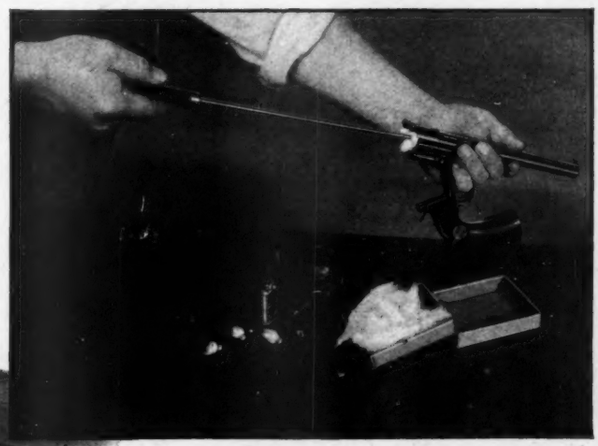
A SNUG-FITTING IRON HOLDER

Because it fits over an electric iron like a sheath, the combination holder and stand at the left can be moved without touching it with the hands, eliminating any danger from burns. Hooks on the stand allow the iron to be hung up out of the way when not in use

NOVEL USES FOR Absorbent Cotton

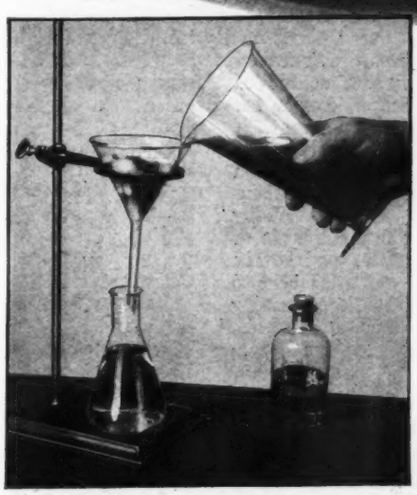


Bits of dry absorbent cotton readily soak up spilled liquids. A part of the liquid can be recovered by squeezing the cotton over a container as shown below



Sportsmen find absorbent cotton to be an ideal material for cleaning the barrels of shotguns, rifles, and pistols. Its soft texture will not mar the finest surface. Parts of delicate tools and instruments can be polished and lubricated by the use of cotton and a fine machine oil

Fine fragments of broken glass, which defy brooms and cleaners, are picked up easily and cleanly with a piece of moistened cotton. By holding the cotton by the unexposed edge and applying with a mopping motion, the user can avoid bringing his hand into contact with the dangerous slivers of glass



An efficient filter for liquids can be made by placing a film of cotton over wire gauze in a laboratory funnel. It is also serviceable to the amateur chemist as a stopper material and as a heat-insulating packing for containers

In the workshop, cotton is handy as padding to keep vises and clamps from making scars on highly polished surfaces. This kink is particularly convenient in fine cabinetwork

Cotton is an excellent filler for cracks and crevices before plaster or cement is applied. In the illustration below, it is being stuffed into a crack between a bath tub and the tile wall, a point where troublesome crevices often appear

Moistened cotton can be used in a humidor to preserve the freshness of tobacco or cigars. Damp layers placed above and below seeds in a box, as at the right, help experimenters in botany to make seeds germinate rapidly

NEW METHODS FOR MAKING OXYGEN and

By Raymona B. Wailes

Simple apparatus for producing oxygen from cobalt chloride and bleaching-powder paste

ALMOST as soon as he has set up his home laboratory, the amateur chemist learns how to make oxygen and hydrogen—two gases with which countless fascinating experiments may be performed. Ordinarily, he uses the stock methods of producing these gases. There are others, however, more or less off the beaten track of laboratory procedure, which are interesting to investigate and frequently offer distinct advantages.

Oxygen gas is usually obtained by heating a mixture of potassium chlorate and manganese dioxide in a test tube or flask. The flow of oxygen resulting, however, is difficult to control. Once started it cannot be checked readily at will.

A more convenient and economical way of making oxygen is as follows: Dissolve three or four grams of cobalt chloride in about a hundred cubic centimeters of water. Place the solution in a liter or half-liter flask. (If accurate measuring devices are not available, the following approximate equivalents will be helpful: five grams of a powdered salt equal one teaspoonful and 240 cubic centimenters are contained in in an eight-ounce drinking glass.) Prepare, also, a thin paste of bleaching powder and water. The bleaching powder may be purchased at a drug, hardware, or grocery store. Although it sometimes masquerades under the name of chloride of lime, its active principle is not calcium chloride but calcium hypochlorite.

Next, using a Bunsen burner or one of the electric heating devices described in earlier articles, heat the cobalt-chloride solution in the flask nearly to the boiling point. Add some of the bleaching-powder paste, which should be thin enough to run freely. A thistle or separatory funnel provides a convenient means of admitting it to the flask.

Oxygen gas is liberated, and may be led off and collected in bottles with the aid of a pneumatic trough. The oxygen comes from the bleaching powder, and more of the paste should be added to the liquid in the flask whenever the stream of bubbles from the collecting trough slackens, indicating a reduced flow of gas. The cobalt chloride solution, which by its presence aids the reaction, may be preserved and used over again at any future time. Compounds of cobalt other than the chloride will serve equally well in this experiment.

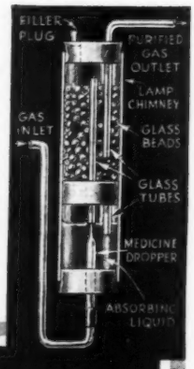
When you have collected the gas given off, in wide-mouthed bottles, you can demonstrate that it is oxygen by a convincing test. Heat a piece of iron wire until it is hot enough to ignite fragments of sulphur with which it is brought in contact. Then lower the wire, with the flaming particles of sulphur adhering, into a freshly opened bottle of the gas you have obtained. The metal will burn with dazzling brilliancy because of the greater intensity of combustion in pure oxygen as compared with air. Charcoal sticks and magnesium ribbon, similarly handled, also produce vivid displays. The sulphur serves as kindling to raise the temperature of the experimental substance to the point of ignition.

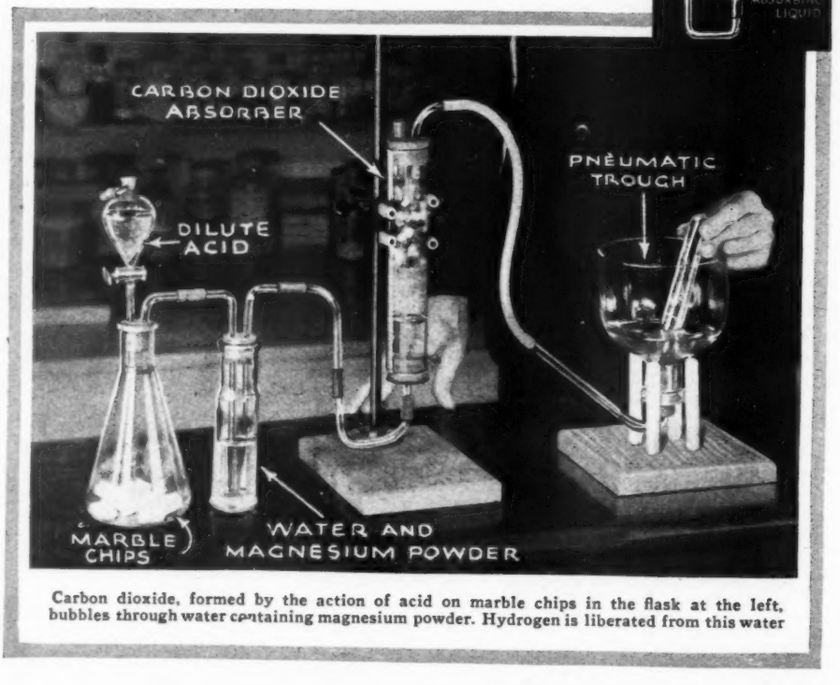
Oxygen, produced on a small scale, offers another entertaining experiment that may be performed with no more equipment than a test tube, a glass pipette or tube, and three chemicals. First pour alcohol—denatured alcohol will do—into the test tube to a depth of about half an inch. Next, admit strong sulphuric acid beneath the alcohol, in such a way that the two layers do not mix. This is not difficult when a pipette or glass tube is used to introduce the acid.

Then drop several crystals of potassium permanganate into the test tube. They will fall to the bottom, where, upon contact with the strong sulphuric acid, they will liberate oxygen gas. Flashes of light will be seen, and a crackling noise heard, as the oxygen comes into contact with the alcohol of the upper layer. This will continue for five or ten minutes, the reaction never slackening until the end. The experiment is a striking one and is perfectly safe to perform.

Hydrogen gas may be produced from as odd a combination of chemicals as carbon dioxide, metallic magnesium, and water. While the cost of the magnesium may deter the amateur chemist from using this as his standard means of supply, the method is interesting for its novelty.

Small pieces of dry ice, dropped into a flask, provide a convenient source of carbon dioxide for the experiment. If dry ice is not available, the carbon dioxide may be generated by adding dilute sulphuric or hydrochloric (muriatic) acid to a flask containing chips of marble. The carbon dioxide





Carbon dioxide, formed by the action of acid on marble chips in the flask at the left, bubbles through water containing magnesium powder. Hydrogen is liberated from this water

HYDROGEN *IN THE HOME LABORATORY*

gas is led into a second flask where it is bubbled through water containing magnesium, either in powdered or ribbon form. In the reaction that occurs, hydrogen gas is liberated from the water that is in contact with the magnesium.

Hydrogen obtained in this way is not pure, but contains a quantity of carbon dioxide gas that has failed to react with the magnesium and water. This carbon dioxide, however, may be removed easily by bubbling the gas through a solution of sodium hydroxide. The purified hydrogen may then be led to a delivery tube, or, if it is to be collected in bottles, to a pneumatic trough.

A device known as a scrubber will aid in absorbing the left-over carbon dioxide gas in the experiment just described. Since this useful little piece of apparatus serves many other purposes in a home laboratory, it will be well worth while to make one.

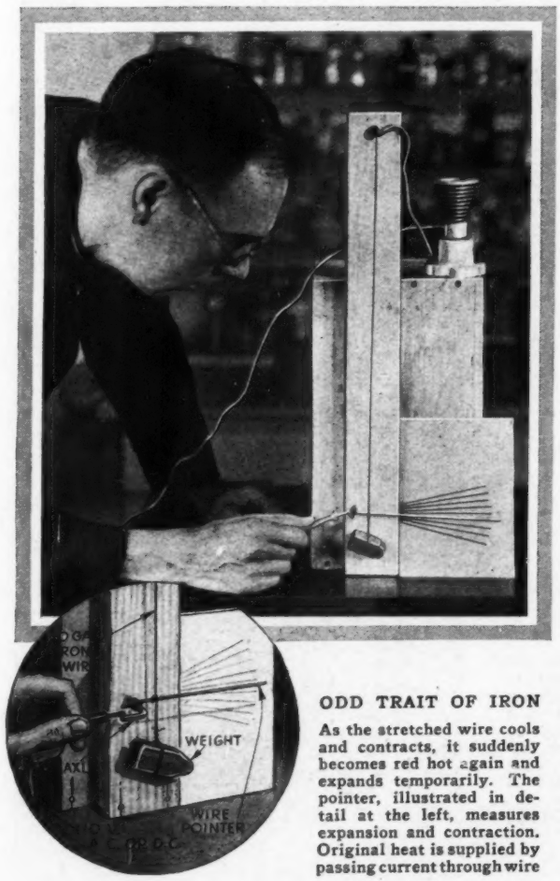
A straight-sided lamp chimney, or an olive bottle with its neck and bottom removed, forms the basis of an efficient, homemade scrubbing bottle. It should be fitted with three rubber stoppers. One of these, at the bottom, has a single hole through which an ordinary medicine dropper is thrust to serve as a gas inlet. A second stopper, inside the tube or chimney, carries two glass tubes arranged as shown in the diagram. The third stopper, at the top, supports a bent outlet tube that delivers the purified gas. It also has a filler hole, closed by a cork, through which sodium hydroxide solution or other absorbing liquids may be added. The upper portion of the scrubber is filled with glass beads, or fragments of broken glass, to the height indicated in the drawing.

Suppose you are making hydrogen gas, by the method described, and you are going to use the scrubbing bottle to absorb the unwanted carbon dioxide gas. Ordinary household lye can be used to prepare the sodium hydroxide required. A teaspoonful dissolved in a glass of water makes a satisfactory solution. Pour into the scrubbing bottle just enough of this solution to cover the upper tip of the medicine dropper. The solution will also run into the inlet tube and fill it to the same level. Now set the hydrogen-making apparatus in operation and connect it with the inlet of the scrubber.

To enter the scrubbing bottle, the gas that is to be purified must force the solution in the inlet tube back into the scrubber. When the first bubble of gas breaks from the tip of the medicine dropper, it passes up the *(Continued on page 103)*

USING A PIPETTE
This picture shows how sulphuric acid is admitted beneath some alcohol in a test tube

Hot Metal Strangely Rekindles Dying Glow



ODD TRAIT OF IRON
As the stretched wire cools and contracts, it suddenly becomes red hot again and expands temporarily. The pointer, illustrated in detail at the left, measures expansion and contraction. Original heat is supplied by passing current through wire

TO EXHIBIT one of the most curious and mysterious properties of iron, only simple apparatus is required. This phenomenon is the ability of the metal, after being heated to incandescence and allowed to cool, to rekindle its dying glow in a brief after-flash of brilliance. In the experiment, the expansion and contraction of the metal can also be demonstrated as heat is applied or removed.

Hang a two-foot length of iron wire from a support and attach a weight at the lower end to hold it taut. To observe any change in length as the wire is heated and cooled, fasten a pointer of stiff wire near the bottom. One end of the pointer is pivoted by wrapping it around an L-shaped hook or a nail, about a half inch from the vertical iron wire. The other, or indicating, end is left free to move across a marked cardboard scale. The vertical wire should be adjusted upward or downward until the pointer is in a horizontal position. This adjustment is facilitated by using, as a support, a screw binding post of the type that clamps a wire passing through it.

The iron wire should now be connected in series with a 500- or 600-watt heating element of the type used in radiant-bowl heaters and through this to a source of 110-volt alternating or direct current. When the circuit is completed by touching the exposed end of an insulated wire to the "axle" of the pointer, as illustrated, electricity flows through the vertical wire and heats it. The heating element in the circuit serves, by its resistance, to prevent excessive flow of current, although it allows enough to pass to make the wire glow.

When current is applied to the iron wire, it soon becomes incandescent. The stiff wire pointer, by falling, shows that the iron has stretched considerably. When the current is interrupted by removing the wire from the pointer's "axle" the iron begins to cool, to lose its brilliance, and to contract as shown by the rising pointer. Suddenly, however, and without any further application of current, the iron glows brightly again. Simultaneously it stretches once more and the pointer may be seen to fall. This surprising reaction lasts but a short time; soon the glow ceases, and the pointer creeps upward to its original position.

The strange behavior of the metal in glowing again, as it cools, is known as recalescence. Some authorities believe the phenomenon indicates that the iron changes from one form to another. The reverse of the reaction is decalescence—a sudden, slight cooling that occurs as the metal's temperature is being raised.

Beginner's All-Wave Set

BECAUSE it combines the essentials of simplicity, low cost, stable operation, and ease of tuning, the all-wave receiver illustrated is an ideal unit for the beginner. When used in conjunction with a good antenna, it is capable of picking up almost any signal that can be received with the more complicated and expensive superheterodyne.

In spite of the fact that the outfit costs less than eight dollars to build, the circuit boasts several valuable features. First of all, it is equipped with an effective mechanical band-spreading system, which eliminates the additional control and the non-uniform coverage defects of the usual shunt-condenser method. Second, the initial, low resistance of the regenerative circuit provides maximum sensitivity while a pentode output tube insures satisfactory earphone reception under most conditions. And third, since two-volt, dry-cell tubes are employed, the small receiver can be adapted easily to portable use. Mounted in a suitable cabinet, it can be made to provide both short- and long-wave programs in locations where electric power is not available.

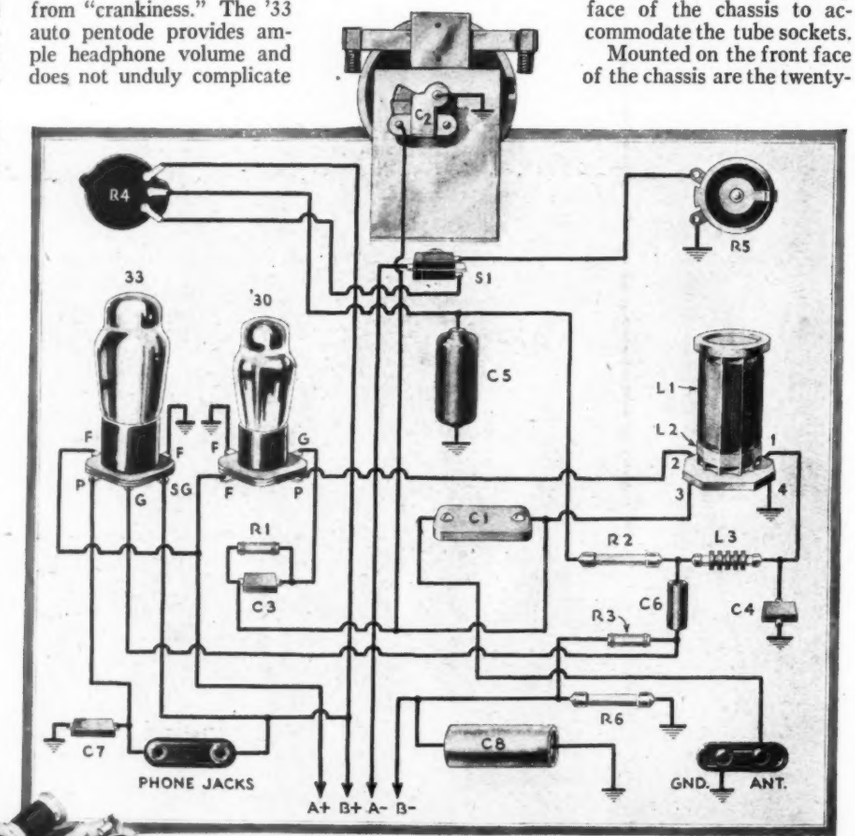
Judged by the actual wiring in the circuit alone, this outfit differs only slightly from many other short-wave sets. However, circuit diagrams as applied to short-wave equipment mean very little as far as indicating just what results may be expected. Rigid adherence to seemingly trivial details is of much greater importance. This particular circuit was designed as a unit that not only can be built easily but that will also operate smoothly. Excess parts have been eliminated and the controls reduced to a minimum.

In most simple short-wave receivers, for instance, band spreading is obtained by means of a small variable condenser shunted across the main tuning condenser. In this circuit, however, the same effect is obtained mechanically. A dual-pointer dial, having one pointer which turns at the same speed as the condenser rotor and another geared to turn very much faster, is used. The former, or minute hand, has a reduction ratio with respect to the control knob of 125 to one, while the band-spread, or second hand, travels at a reduction ratio of approximately three to one. Thus it can be seen that the condenser rotor, traveling at a reduction ratio of 125 to one, makes it practically impossible to skip over carriers, while the second pointer, traveling about forty times faster than the condenser, readily permits accurate logging of stations.

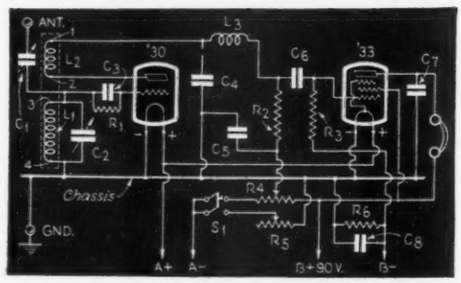
The tubes employed are types '30 and '33. The '30 was chosen in preference to the '32 and '34 tetrodes because of its greater stability and freedom from "crankiness." The '33 auto pentode provides ample headphone volume and does not unduly complicate the construction since its biasing voltage is obtained from a resistor (R_6) located in the "B"-supply return. The series-connected dry cells are used to furnish the filament power, and two forty-five-volt "B" blocks supply the plate voltage. A rheostat (R_5) is provided to drop the dry-cell voltage to the required two volts.

On the top face of the chassis are mounted the dual-pointer dial, tuning condenser, coil socket, and antenna-coupling condenser. The tuning condenser (C_2) is mounted three and one half inches above the chassis by means of an aluminum bracket which measures three inches wide by four inches high with a one- by three-inch mounting area at the bottom. This bracket can be formed easily by bending a three- by five-inch piece of No. 14 gauge aluminum to the required dimensions. Six screws, arranged in two rows, completely eliminate backlash effects in the mounting. It also will be noted that it is necessary to cut two 1⅛-inch holes in the top face of the chassis to accommodate the tube sockets.

Mounted on the front face of the chassis are the twenty-



Simplicity is the distinguishing feature of this set, as shown by the picture diagram above and schematic diagram at right. The method of mounting the novel mechanical band-spreading unit which eliminates the need of additional control, is shown in photograph at the left



Built for Eight Dollars

By J. A. Worcester, Jr.

ohm rheostat, (R_5) and the regeneration control potentiometer (R_4). Also on the front, and directly below the tuning knob, is located the double-pole, single-throw switch (S_1). This switch is wired so that opening the filament circuit also opens the return leg of the potentiometer, thus preventing any current drain through the potentiometer resistance when the set is not in operation.

The twin binding-post assembly for the antenna and ground and the twin-speaker jack are mounted at the rear of the chassis. A centrally located hole also is provided to accommodate the battery cable.

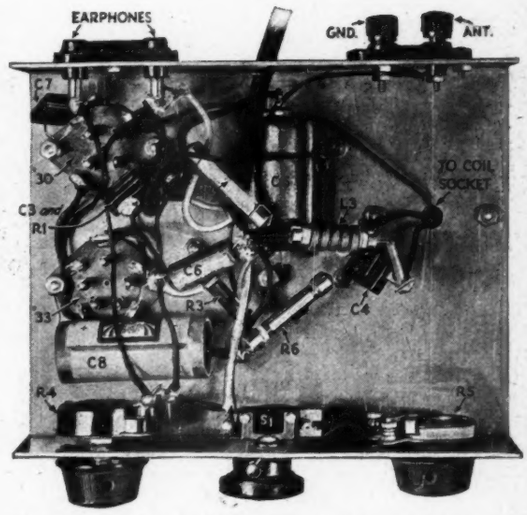
The tube sockets, chokes, resistors, and fixed condensers are mounted under the chassis. These latter components are mounted directly at the proper points by means of their pigtails. The grid leak and condenser combination (R_1 and C_3), should be mounted directly on the grid terminal of the detector-tube socket to obtain maximum stability. The radio-frequency choke (L_3) and the by-pass condenser (C_4) should be mounted directly below the coil socket. In wiring the dry electrolytic condenser (C_8), the positive terminal should be grounded.

When buying the parts for this receiver, select them carefully. Use high grade commercial coils that have been carefully constructed for low-loss operation and avoid the use of a variable condenser not specifically designed for short-wave use. If, after you have the set completed, you find that it produces a loud hissing or squealing sound, which not only is uncomfortable but practically makes it impossible to tune in code signals, it is a fairly dependable sign that the grid and tickler windings on the coils do not match.

To put the set in operation, simply make the proper battery connections, attach the aerial and ground, and connect the phones. If possible, a voltmeter should be employed to adjust the filament-terminal voltage to exactly two volts. Lacking this, the rheostat should be advanced until the filament glow is barely perceptible. The regeneration control then should be advanced until a very slight hiss is heard indicating an oscillating condition. This can be checked periodically by touching the stator (stationary) terminal of the tuning condenser with a moistened finger and advancing the regeneration control until distinct clicks are noticeable each time the contact is made. These clicks should be much more pronounced than those produced by touching the chassis.

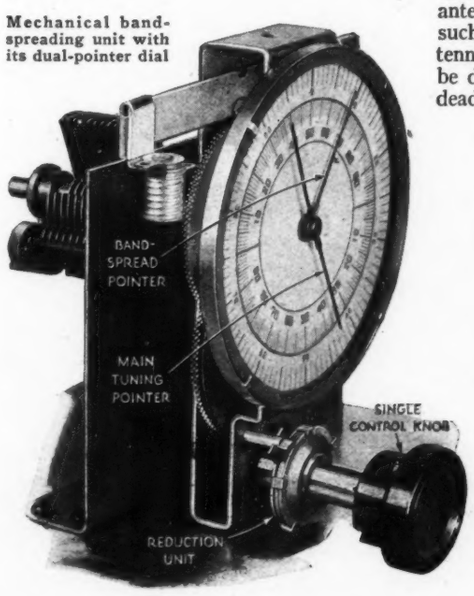
If the antenna-coupling condenser is adjusted too tightly, it will be almost impossible to produce oscillations. When employing the smallest coil, this condenser should be practically "wide open," while with the largest coil it may be advanced to perhaps three fourths of its total value. The intermediate coils generally will require corresponding changes in the antenna-condenser setting. If the setting is too large, the set will not oscillate; if it is too small, the energy transfer will be insufficient and the detector will oscillate at too low a potentiometer setting, resulting in reduced gain.

All regenerative receivers experience the phenomenon of dead spots. These are caused by antenna resonance and when such a condition occurs the antenna-condenser capacity should be decreased in value until the dead spot disappears.



Two views of the chassis. In the upper picture, the top of the chassis is seen from the rear, with positions of tubes, plug-in coil, and condensers. The lower picture shows the mounting of the various units on the underside of chassis

Mechanical band-spreading unit with its dual-pointer dial



PARTS REQUIRED

L_1 and L_2.—Set of four short-wave, plug-in coils and one broadcast coil, 17-560 meters.
L_3.—R.F. choke, 2.3 mh.
C_1.—Padding condenser, 10-70 mmf.
C_2.—Variable midget condenser, 140 mmf.
C_3.—Mica condenser, .0001 mfd.
C_4.—Mica condenser, .0005 mfd.
C_5.—Tubular paper condenser, .5 mfd.
C_6.—Tubular paper condenser, .01 mfd.
C_7.—Mica condenser, .002 mfd.
C_8.—Dry electrolytic condenser, 25 mfd., 25 volt.
R_1.—Grid leak, 2 meg.
R_2.—Metallized resistor, 100,000 ohm.
R_3.—Metallized resistor, 500,000 ohm.
R_4.—Potentiometer, 50,000 ohm.
R_5.—Rheostat, 20 ohm.
R_6.—Metallized resistor, 500 ohm.
S_1.—Switch, double-pole single-throw.

Miscellaneous: Double-pointer, band-spread dial with planetary reduction attachment, chassis, one four-prong wafer socket, one five-prong wafer socket, one coil socket, twin binding-post strip, speaker jack, tubes, etc.

SHORT CUTS AND TOOLS *for the* Radio Builder

A tube-base adapter connects "station finder" with receiver

Oscillator Unit Simplifies Short-Wave Tuning

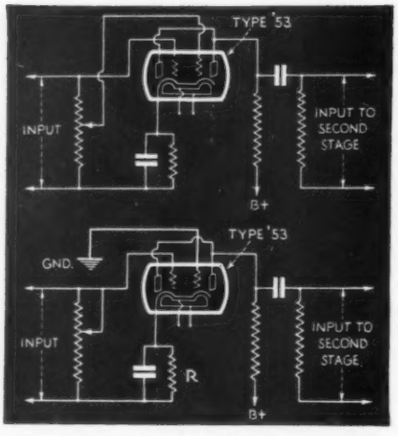
ALTHOUGH called a "station finder," the small, black box pictured at the left is in reality a miniature oscillator so arranged that it may be used as a tuning aid to locate and properly tune in long-distance short-wave signals. Connected to the receiver by means of a short cable and a tube-base adapter inserted under the first intermediate-frequency tube, the device requires the use of only one additional tube; a type '37 if the receiver employs 6.3-volt tubes, or a type '27 with 2.5-volt tubes. In use, the station finder is turned on by means of a toggle switch. As the tuning dial of the receiver is then rotated slowly, an audio note is heard whenever a station's carrier wave is turned in. When this note has been tuned to its maximum volume, the station finder is turned off and the actual signal, accurately dialed, is heard. Continuous-wave signals are heard by operating the receiver with station finder on.

New Plug Insures Good Cable Connections

MAKING use of prongs, like the base of a radio tube, these molded composition plugs insure tight, yet easily opened, cable connections. Fitted with metal screw caps, they cannot be pulled open accidentally and the multiple connections they provide make them particularly useful in automobile-radio installations, public-address work, and in other jobs requiring semi-permanent connections.

Novel Use of '53 Tube Improves Quality

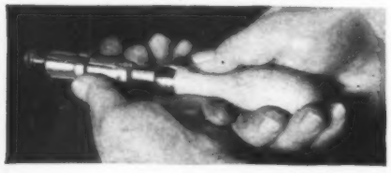
A TYPE '53 class "B" amplifier tube can be used as a class "A" amplifier by connecting the corresponding elements of each half of the tube in parallel, and using the whole as an ordinary three-element tube. Since this arrangement gives the tube a low output impedance, it is an ideal circuit for use with transformer coupling. An increase in quality, with no sacrifice of volume, also may be obtained by a variation of this circuit. As shown in the second diagram, one grid is connected to ground and the cathode resistance *(R)* is increased to twice its normal value. The grounded grid here provides a constant bias voltage for the second grid, and improves the quality of the amplifier.



Diagrams show two hook-ups for using type '53 class "B" amplifier tube as a class "A" amplifier

Indicator Shows When Receiver Output Is Best

WITH the output indicator illustrated above, the job of "lining up" a receiver circuit is not only simplified but the results obtained far surpass those possible by trying to judge the output by the relative loudness of the speaker. Essentially, the device is made up of three parts—a transformer, a neon lamp, and a potentiometer—mounted in a small composition case. In use, the indicator is wired across the loudspeaker voice-coil connections and the potentiometer reduced until the neon lamp is barely glowing. The receiver circuit then is adjusted until the neon lamp shows its maximum brilliance. Terminals make it possible to use the gauge with speaker coils of various resistances.

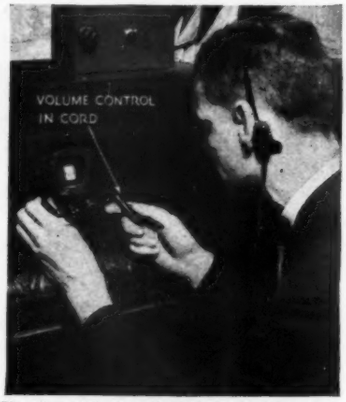


Wrench for Knurled Nuts

DESIGNED especially for use with knurled nuts, a new wrench simplifies the problem of mounting panel-type instruments. It consists of a segmented metal tube, fitted with a sliding ring, which draws the sections together as it is pushed toward the nut. The ends of the tube segments are recessed to grip the nut.

Helps Deaf to Hear Radio

BY FITTING his receiver with a new adaptation of the "bone conduction" type of hearing aid, a deaf person can now enjoy radio programs without interfering with the regular operation of the set. The unit plugs into the output of the receiver, has a volume control built into its connection cord, and operates independently of the regular loudspeaker. The user may turn it on or off, or adjust the volume, without affecting the operation of the receiver. This arrangement also can be used in hospitals. By detaching the headband from the oscillator and placing the midget unit under a pillow, a patient can hear without annoying others. Several units, the volume of each controlled independently, can be used simultaneously.



Hearing aid plugs into output of receiver

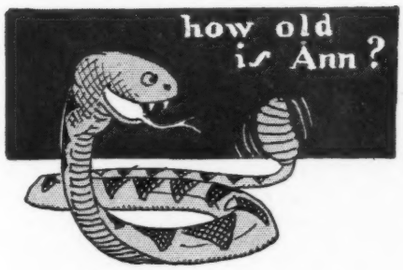
Question: Is catgut really made from the intestines of a cat?—M. J. C., Detroit, Mich.

Here's *the* Answer

THERE is no cat in catgut. It is made from the intestines of sheep and other cattle. The name catgut is of uncertain origin. Some authorities believe it to be a corruption of the word kitgut—kit being an old name for a small violin. Others suggest that it is a contraction of the word cattle-gut. Association of catgut with the cat is a common error.

Slicing It Thin

T. H., CINCINNATI, OHIO. Gold is the most malleable metal known. It has been beaten into gold leaf so thin that 300,000 sheets were required to make a pile one inch high.



Tail Rattles No Telltale

Q.—CAN the number of rattles on a rattlesnake's tail be used as an infallible indication of the snake's age?—F. B., Tucson, Ariz.

A.—ONE cannot determine the age of a rattlesnake by the number of rattles on its tail. Rattlesnakes often grow more than one rattle each year. Also, rattles are frequently lost as the snake travels about.

The Earth as a Quaker

Q.—ARE there any records which show how many earthquakes have been reported scientifically?—R. H. M., Vancouver, B.C., Canada.

A.—THE limited number of seismographs that have been in use for the last thirty-five years have recorded, it is estimated, nearly 2,500 major earthquakes and about 140,000 minor ones. A large number of earth tremors, local in extent, have probably never been recorded.

A Dark Exposure

Q.—DOES sepia, the brown dye, come from a plant or animal source?—G. W. B., Galveston, Texas.

A.—THE dark brown pigment sepia is obtained from the ink-sacs of certain varieties of cuttlefish. When the animals are caught for this purpose, the ink-sac is promptly removed and quickly dried to prevent putrefaction. The pigment is prepared from this residue.

A Guide for Whitewashing

Q.—I AM planning to do a calcimine or whitewash job at home. Can you furnish me with a table which would be helpful in calculating the amount of paint needed?—A. H. A., Bath, Me.

A.—A GALLON of whitewash, or cold-water paint, will cover approximately the following areas: on wood, 225 square feet; on brick, 180 square feet; on plaster, 270 square feet; and on rough walls, twenty-two square yards.

Mending Those Acid Jars

R. A., INDIANAPOLIS, IND. An effective method of making cracked glass or porcelain acid jars tight is to use the following cement for sealing the cracks. To finely sifted sand, short-fiber asbestos, and a little magnesia, add enough concentrated water glass to make an easily kneadable mass. The action of acid on this cement renders it firm.

Doesn't Faze Nitrogen

Q.—WHAT happens to the nitrogen of the air when it passes through the engine of an automobile?—A. A. N., Wilmington, Del.

A.—THE nitrogen of the air is an inert gas and passes through the automobile motor unchanged.

Dogs Take the Count

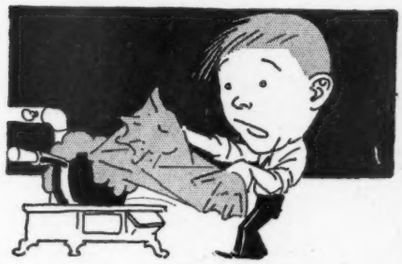
L. W., CHICAGO, ILL. Estimates from reliable sources place the total number of dogs in the United States at approximately 8,000,000.

No Place for Dieters

W. W., JACKSON HEIGHTS, N. Y. An object which weighs 190 pounds at the equator (sea level) would weigh approximately 191 pounds on a spring balance, at either of the earth's poles. Due to the flattened areas at the poles, these surfaces are thirteen and one half miles nearer the earth's center than a point on the equator. Naturally, the force of gravity is greater.

A Momentous Angle

S. W. N., DES MOINES, IOWA. There is only a narrow strip of the earth's surface, theoretically a mere line, lying under the equator, where days and nights are equal throughout the year. Day and night would be equal during the whole year over all the earth, and there would be no change of seasons, if the axis of the earth were perpendicular to the plane of its orbit. But the earth's axis makes an angle of 23.5 degrees with the plane of its orbit, and this fact accounts for all the variations of night and day and the seasons.



The Great Mail Stickup

Q.—PLEASE give me a good formula for gummed-label glue.—M. S., Albany, N. Y.

A.—THE gum used by the United States Post Office Department on postage stamps is probably one of the best that could be used for labels. It will adhere to almost any surface. Its composition is said to be as follows: gum arabic, one part; starch, one part; sugar, four parts; water, sufficient to give the desired consistency. The gum arabic is first dissolved in water, the sugar is added, then the starch, after which the mixture is boiled for a few minutes in order to dissolve the starch. Next, the resulting gum is thinned to the desired consistency.

When Ships Fly Flames

Q.—WHAT is St. Elmo's fire? I have heard sailors make reference to it.—P. B., Baltimore, Md.

A.—DURING heavy electrical storms at night, a blue light is sometimes observed at the tips of masts and yards of vessels at sea. Sailors call this phenomenon "St. Elmo's fire." It is explained by the fact that large, induced charges of electricity are leaking off into the surrounding air. This same faint, bluish glow can occasionally be seen on land, under similar conditions, at the tips of lightning rods.

A Whale of a Fish

I. W., KENOSHA, WIS. The largest fish is probably the whale shark which has been measured up to a length of forty-five feet. Experienced persons have estimated some specimens encountered to have been sixty or seventy feet in length. The whale, which sometimes has a length of more than 100 feet, is not a fish, but a mammal.

Too Cold To Shiver

Q.—IF A substance were placed in a cylinder and the temperature could be reduced to absolute zero, would that object disappear?—C. V. D., Rutherford, N. J.

A.—WHEN matter is heated, the vibration of the component molecules increases. As more heat is applied, the motion becomes greater. Conversely, when matter is cooled, the motion of the mole- *(Continued on page 100)*

By MARTIN BUNN

Joe was just at the point of admitting he was stumped, when, to his intense relief, he heard the rattle of the service car, and Gus drove up

GUS TELLS How to Stop Brake Chatter

"GOOD grief! Now I'm in for it," groaned Joe Clark, as he glanced out of the window of the tiny office of the Model Garage. A small sedan was just pulling up in front of the establishment, to the accompaniment of a most unpleasant chattering noise.

Gus Wilson, his partner and the mechanic of the firm, was out on a job with the service car, so Joe tossed aside his pencil and went out to see what he could do for the tall, angular woman who was climbing out of the sedan.

"Howdy, Miss Simpkins. Some little trouble we can fix for you today?" Joe saluted her with a hopeful smile.

"Where's Mr. Wilson?" the customer snapped, glaring at Joe. "I want to give him a piece of my mind! You swindlers relined the brakes on this car only three months ago, and now see how it acts! What kind of brake lining did you use—pasteboard? Every time I put my foot on the brake, the car starts to shake and chatter. It's making me a nervous wreck. I want it fixed *right now*, and I don't expect to pay for your time, either!"

"We'll do that gladly, Miss Simpkins," Joe agreed, hastily. "We guarantee all work. Probably a bit of grease has worked into the linings; something like that. I'll see to it right away."

Joe cast a despairing look down the road to see if by any chance Gus was returning. As there was no sign of the service car, he went inside for a kit of tools.

"Just my luck to have that eagle-eyed old hen on my neck the minute Gus gets out of sight," he grumbled disgustedly, as he grabbed the tool kit and a small can into which he could draw some gasoline to wash out the grease he suspected was causing the trouble.

He had Miss Simpkins start and stop in front of the garage a couple of times. Each time she put on the brake, a most alarming noise broke out and continued almost until the car had reached a complete stop.

"Now I'll have a look at those brakes," he said, wheeling the garage jack under the front axle and lifting both wheels off the ground. There seemed to be no doubt that the chattering noise was coming from the front end of the car.

Miss Simpkins promptly climbed out and came around to watch the job. This didn't improve matters for Joe. A bit clumsy with tools at best, the little bookkeeper found all his fingers turning to thumbs under this distinctly hostile scrutiny. However, he kept at it until both front wheels and the hubs were off. No trace of grease appeared on the brake facing of either wheel.

"There! I just knew it would turn out you were wrong," Miss Simpkins observed triumphantly. "Anybody should know that slippery grease couldn't make anything stick and chatter."

As science teacher in the local high school, Miss Simpkins prided herself on her mechanical knowledge.

Joe admitted his error and proceeded to stall along with a minute examination of the brake surface while he racked his brain trying to figure out what could really be the matter.

He was just at the point of admitting he was stumped, when, to his intense relief, he heard the familiar rattle of the old service car, and Gus drove up.

There was a twinkle in the veteran auto mechanic's eye as he took in the situation. He promptly came to his partner's rescue.

"Having trouble with that brake job we did for you, Miss Simpkins?" he asked with a smile. "I see Joe is well along with it." He turned to his partner with a wink, "Mr. Thomas wants you to call him at once. I'll finish this."

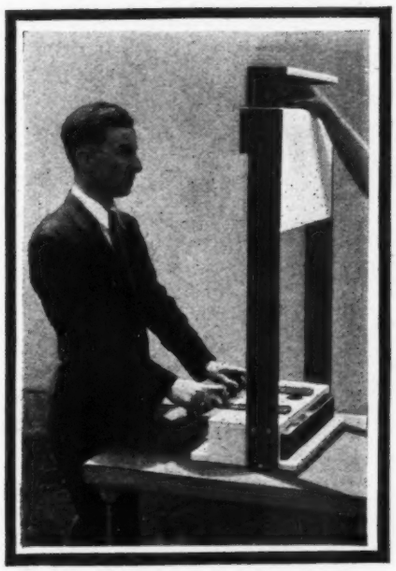
JOE took the hint and headed for the office, after explaining to Gus what the symptoms were.

"Chattering brakes are not very common these days, Miss Simpkins," Gus remarked, as he tested for play in one of the brake connections. "Grease can do it, sometimes. A greasy brake shoe may act like a rubber heel on wet pavement. The heel holds all right till it starts to slip, but once it starts, the water forms a cushion under it and you slide like you would on ice. If the brake-drum surface happens to be a *(Continued on page 108)*

To win this entertaining contest, you have to be a little quicker than the other fellow . . . It's a test of speed devised by Paul R. Rannie

NEW Marble Game

PLAYED BY PITCHER AND BATTER LIKE BASEBALL



One player drops a marble, and the other has to stop its fall by moving one of two levers

HERE is an easily made marble game of new design that can be played by two or more persons in a variety of entertaining contests. It can be used simply as a test for quickness and as a sort of pitcher-and-batter contest, or a modified form of baseball may be played with it. The players can be handicapped according to their skill, if necessary. Used either indoors or outdoors, it will provide no end of fun for parties.

The secret of its fascination lies in the fact that it is much more than a game of chance. In fact, it was designed, not primarily as a game, but as a test of what is known as "reaction time." With it you can make the same sort of tests that have been given to Babe Ruth and many other athletes in order to find out how much more quickly they act than the average individual.

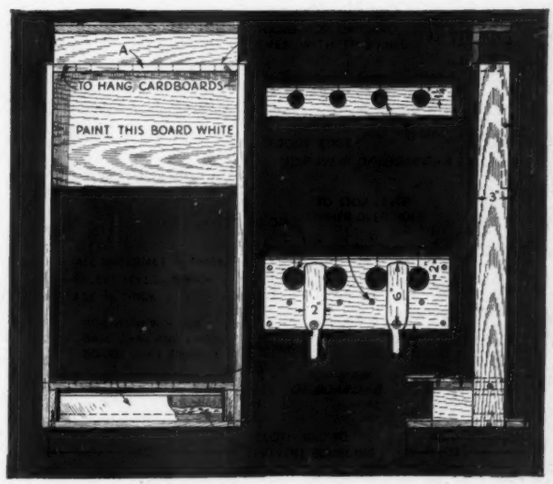
Skill in games such as tennis or baseball or in handling a car or airplane depends largely on the ability of your nerves and muscles to work quickly. This device will measure how fast you respond.

The principle is simple. A large marble is dropped through one of four openings, and the other player (or the one being tested) must move quickly to prevent it from entering the corresponding hole in the lower part. He does this by moving one of two levers in the proper direction, a lever being held with each hand.

The time in which the person must react is accurately measured by the distance through which the marble falls. This time interval is made shorter by shielding the first part of the fall with strips of cardboard of different widths. In this manner time intervals of .30, .25, .23, .21, or .20 of a second are obtained between the moment when the marble is first seen and the time it reaches the lower hole. Without a cardboard, it is about .35 of a second.

The construction is shown in the photograph and drawings. The four top holes, of course, should be directly over the bottom holes. The top holes should be from ¼ to ⅛ in. larger than the marbles used because a marble will not drop straight if it touches the side of the hole. In this case the upper holes were made 1⅜ in. in diameter.

The wide board, which is painted white, provides a good background for viewing the marbles as they emerge from the top holes or from *(Continued on page 77)*



Front and side views of the "reaction time" game, and detail drawings to give the dimensions of the marble holes and levers

PRACTICAL *Marionettes* MADE FROM OLD INNER TUBES

A new, simple, and inexpensive way to prepare puppets . . . Two types of controls . . . How to tie strings

By FLORENCE C. DRAKE

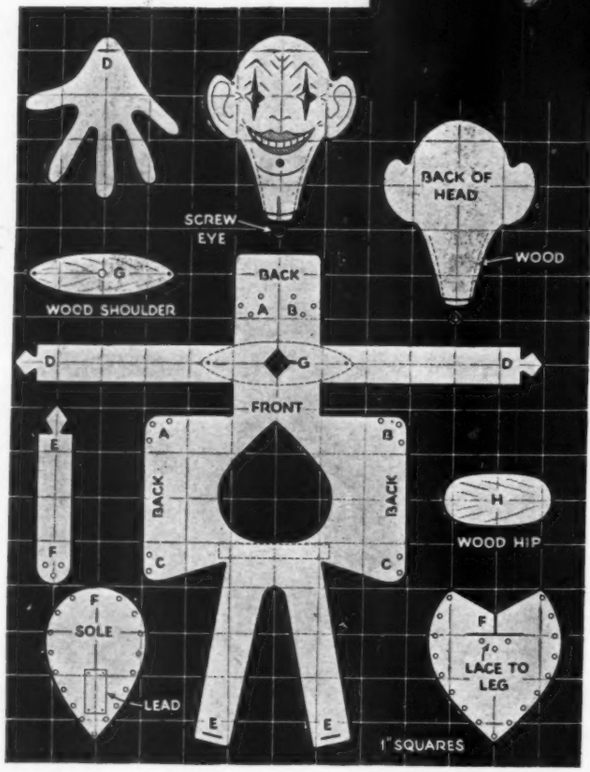
MARIONETTES of a picturesque, flexible, and entirely practical type may be made from discarded inner tubes. They cost practically nothing, and the method of construction is simplicity itself.

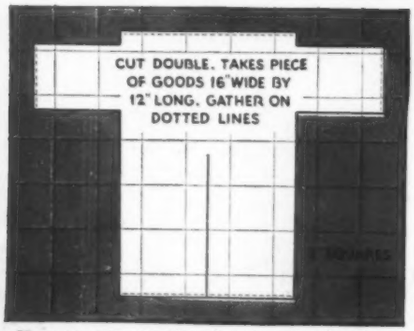
Directions will be given in detail for a clown puppet. When the general method is understood, original puppets can be devised at will. These can be costumed characters or amusing grotesque figures of rubber alone. The number of fantastic animal creatures one can make in this way is legion.

If there are no old inner tubes in the garage to be cut up for this purpose, a supply may be had at most tire repair shops for a few cents each and often merely for the asking. It is surprising in what variety of soft, lovely colors they come—cream, fawn, terra cotta, blue, and black. When other colors are required, bathing caps, hot-water bags, and other cast-off rubber articles will furnish a supply. The face of the clown, for example, is of white rubber from an old bathing cap.

The materials required for the clown are, in addition to the rubber, cotton for stuffing the head, screw eyes, scraps of wood, some cigar-box wood, a spool of carpet thread, a spool of fine copper wire, wooden dowels, sheet lead or shot, paints and colored ink. The tools are simply scissors, pliers, coping saw, drill, and a paper punch of the type used for punching tickets.

The clown puppet in the spotlight. Its dancing action is particularly realistic because body and limbs are so pliable. At left are patterns for making the few parts required





How to cut out the clown's suit. A colorful neck ruff and sleeve frills may be added

First cut a piece of inner tube of sufficient size and clean it carefully with soap and water. While the rubber is drying, you can make the patterns. Draw the full-size designs of the various rubber parts on stiff paper, place these on the material, trace around the patterns, and cut the pieces out of rubber.

The body, arms, and thighs of the clown are all in one piece. There are two leg pieces, two upper and two lower foot pieces, two hands, and the front and back of the head. These are cut from the inner tube with the exception of the hands and head covering, which are thin white rubber.

Three wooden parts are also required—a shoulder piece whittled to a blunt point at each end as shown, a shorter and wider hip piece (these may be ⅜ or ¼ in. thick), and a round tapered stick about 2½ in. long to stiffen the head.

To assemble the puppet, punch holes where indicated by the dots on the patterns and cut the various slits. Then slip the arrowhead ends of the various parts into the corresponding slits (*D* to *D* and *E* to *E*). The holes *A A*, *B B*, and *C C* are to be laced together with thin wire, carpet thread, or thongs of rubber.

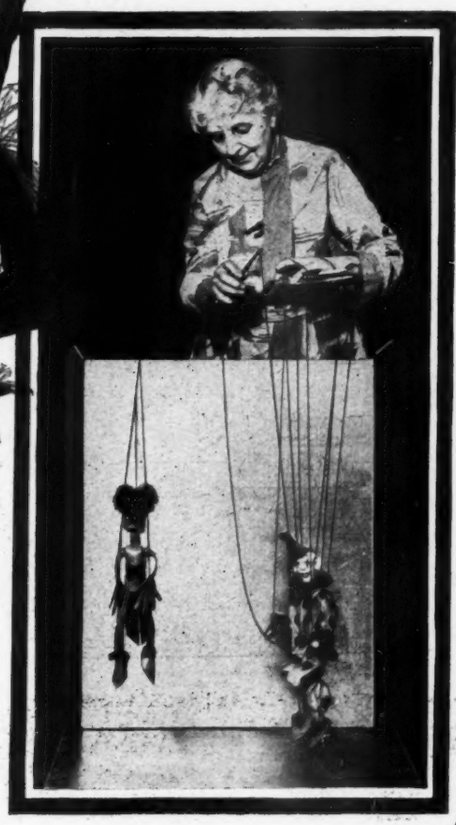
Attach pieces of lead to the soles with wire (or use shot sewn in cloth). Then slit the upper part of each foot as indicated by the crossed lines and lace it to the sole. Lace the foot to the leg by means of the three holes marked *F* in each of the leg pieces.

Draw the features with black ink and add spots of red as desired. Sew face and back of head together, leaving an opening at base of neck. Fill with soft cotton, push in the round, tapered stick as indicated by the dotted lines, and drive in wire nails to hold it in place.

Put a screw eye in the end of the head stick. Draw a 7-in. length of copper wire through the screw eye and bend together at both ends. Slip the ends through the hole in the rubber at *G*, then through the wood shoulder piece. Each end is then

YOU'LL like to make puppets by the method described in the accompanying article—it's so quick and easy and effective. Most homemade puppets are too stiff, but these are very flexible.

Mrs. Drake, who devised this ingenious new type of marionette, is a puppeteer of many years' experience and a teacher of the art of making marionettes. Her puppets have been exhibited at Columbia University, New York, and in the DeYoung Museum, San Francisco, Calif.



Grotesque head made entirely of rubber with fur for the hair and mustache. Inside, a large spool fills it out from ear to ear. *At right:* Mrs. Drake operating the clown

bent back at right angles and firmly tacked to the underside of the wood. Allow enough wire to give free movement to the head. Two screw eyes are inserted through the rubber into the wood shoulder piece near the ends at the points indicated by dots; these are for the shoulder strings.

The simplest way to make the clown's suit is to follow the pattern given. It is cut double and takes two pieces of goods 16 in. wide and 12 in. long. Gather the cloth where indicated by the dotted lines, and add a neck ruff and sleeve frills of red netting or other suitable material.

Two dowel sticks 9 in. long may be used to control the puppet. Slight incisions are made ¼ in. from the ends on both rods, and two extra ones 3½ in. from the ends. To the outer ends of one rod are tied the leg strings, and to the inner incisions are fastened the arm strings. The other control rod supports the head and body, the outer incisions carrying the head strings. If a back string is desired, notch the center of the stick in the exact middle.

A more elaborate type of control is shown in one of the diagrams. Experienced puppeteers now prefer a small, light control about the length of the hand and as wide as the span of the thumb and little finger—usually about 8 by 9 in. Cigar-box wood cut in strips is excellent for the purpose. Small holes are drilled in the ends through which strings are passed and securely tied.

Large holes are made in the piece marked No. 4 to hold a thong of rubber tubing that slips over the hand and supports the control and puppet, leaving the fingers free for working special strings.

For the hand strings, wire loops are inserted in, or fastened to, the front of piece No. 1 so that they project a trifle, making it easier to lift the string. This string is continuous and runs through a loose brass ring between the two wire loops. The leg piece (No. 2) is detachable, and should slip easily over a nail projecting about 1 in. from piece No. 1. Pieces 1, 3, and 4 are tacked and glued together. The control may be hung by wire, leather, or any strong material. It is best to keep the puppet hanging up. Never lay a puppet down without winding the strings around the control.

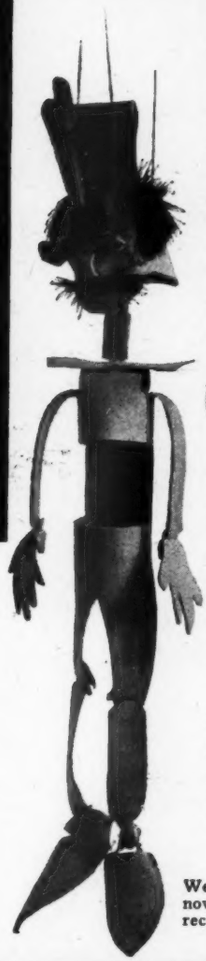
The length of the strings varies. It depends upon the individual puppeteer and the particular stage. Cut the shoulder thread 3 in. longer than double the distance from the control to the marionette's shoulder. Hold the marionette upright with its feet on the floor, tie one end securely to the marionette's left shoulder, tie the other end to the right shoulder, cut the string exactly in half, pass one end through the left hole in piece No. 4 of the control, tie securely, and do the same with right string.

Tie a string to the head back of the left ear, measure double the distance from that point to the control with head erect, allow 3 in. extra, and cut the string. Cut in half, pass left string through hole in left side of No. 3, and tie. Repeat on right side.

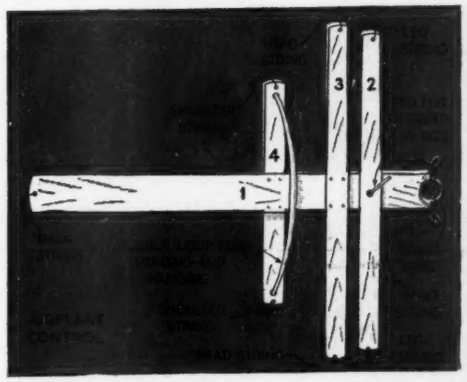
Be sure the weight of the body hangs from the shoulder strings. If these are slack, the head strings are supporting the marionette, and the head movement will be stiff. If the head strings are too far forward, the head will be drawn back too much; if they are placed too far back, the head will fall forward. For a pompous, strutting character, place the strings forward. For old age, or a hunchback, set the strings far back.

Next, tie a string to the left hand through palm and thumb, measure up to the control and back, allow 3 in., cut and pass the free end through the left loop of the main control, then through the brass ring, down through the right loop, and tie to the right hand. Tie a string to the marionette's back, a little above the waistline. Use a needle to draw it through the costume if necessary. Draw the string through the hole in the back of the main control bar and tie securely. In the same manner, tie strings to left and right legs above the knee joints, and tie through holes in the detached bar marked No. 2.

If you would like to see more articles on marionettes published in future issues of POPULAR SCIENCE MONTHLY, *please send a post card to the Home Workshop Department.*

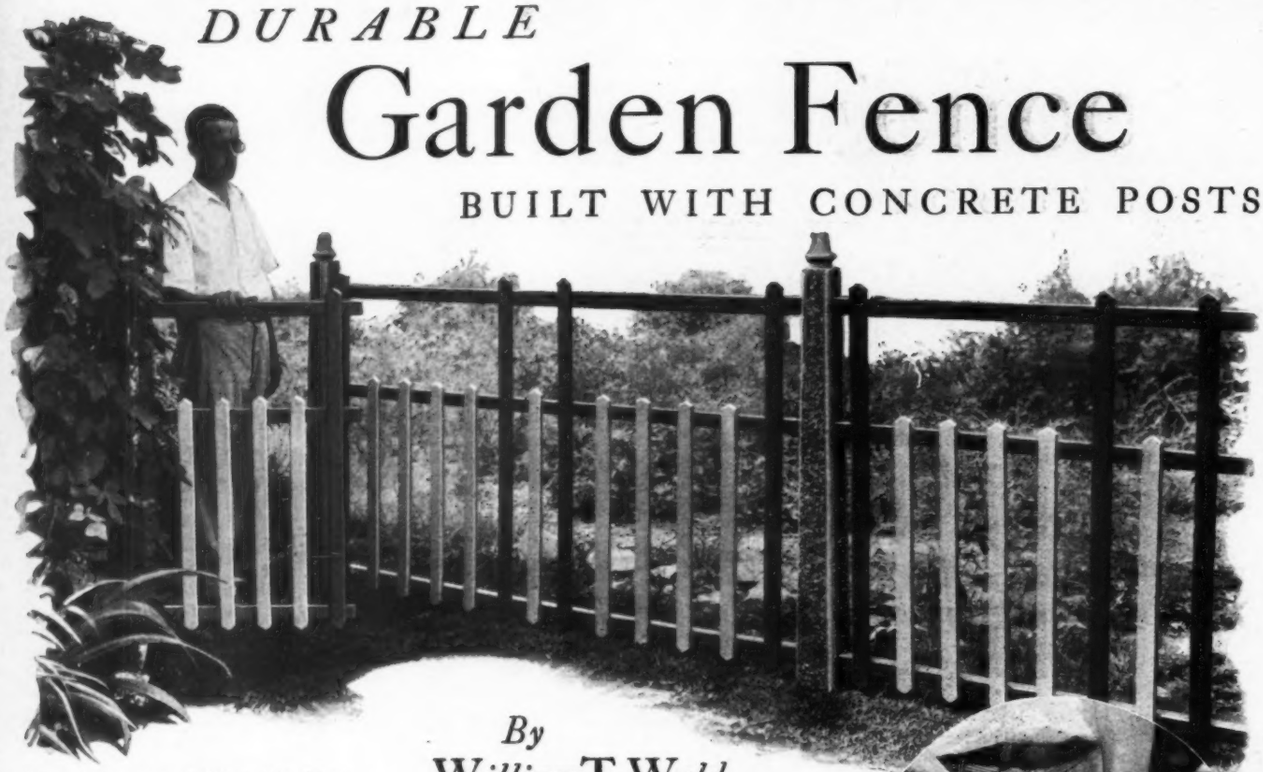


Weird all-rubber puppet for novelty acts and, below, the recommended type of control



SAVE time by using our construction kits—see page 88.

DURABLE
Garden Fence
BUILT WITH CONCRETE POSTS



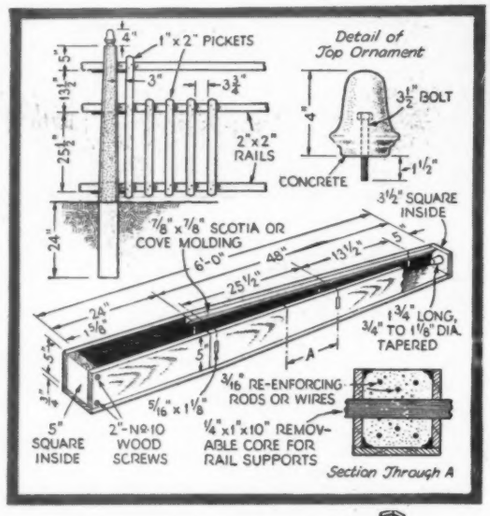
By
William T. Weld

The materials for building this fence cost only about a third as much as plain wire fencing on cedar posts, yet it is more attractive and will last far longer

FROM the viewpoint of security and neatness, a good fence is a great aid to the back-yard gardener. Expense is the principal drawback. Even an ordinary fence of cedar posts and wire for a small lot is likely to cost $100 for materials, and it is not only unattractive, but it rarely lasts more than a few years. The trellis fence illustrated, which is much more durable, can be built for about a third as much.

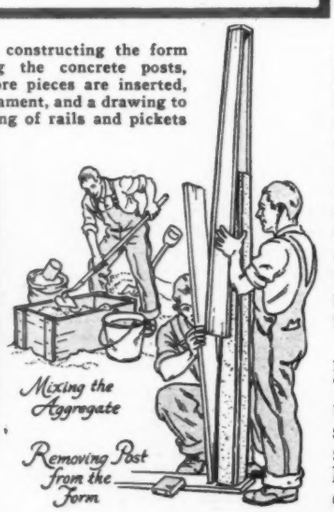
The form for the concrete posts is made as shown in the drawing at the right. It is filled with a mixture of 1 part cement, 2 parts sand, and 3 or 4 parts torpedo gravel, sometimes called roofing gravel. For 30 posts, I used 1 ton sand, 2 tons gravel, and 4 sacks of cement. Each post takes about 1 cu. ft. of the mixture. If a box 12 by 12 by 12 in. is used for a measure, very little concrete will be wasted.

Mix the materials very thoroughly while dry, then add water slowly until the mix



Method of constructing the form for casting the concrete posts, how the core pieces are inserted, the top ornament, and a drawing to show spacing of rails and pickets

Since the fence is of trellis design, it is intended to be covered, in part or whole, with vines. This is a section of Mr. Weld's fence after it had been erected for some time



Removing one of the top ornaments from the mold, which is nothing more than the upper part of a junked electric ceiling fixture

will slide off a shovel easily. When poured into the form, it should be "quaky"—that is, it should shake a little like jelly. The form should be well oiled inside. Used crank-case oil will serve for this purpose.

To strengthen each post, I used about eight vertical strands of old woven wire fencing from the junk yard, but four 3/16-in. reënforcing rods would be even better. Shovel in about 1 in. of the mix, lay in several long strands of wire, put in the three cores to make the openings for the rail supports, fill in almost to the top of the form, place the other reënforcements, and complete the filling. Tap the outside of the form lightly with a hammer to jar the concrete, and scrape off any surplus from the top. The core pieces should be moved back and forth occasionally while the concrete is setting.

If a post is poured in the afternoon, it may be removed the following morning. Take out the cores first, remove the bottom block, stand the form on end, and slide it upwards. Hold a board along one surface to stiffen the still fragile post and lower it gently to a horizontal position, either on the *(Continued on page 97)*

MY METHODS OF

Coloring Ship Models

By Capt. E. Armitage McCann

When painting a model such as the *Hartford*, shown at left, Captain McCann takes as much trouble as any artist working on canvas. He urges model makers not to slight this important part of the work

THE correct coloring of ship models is of vital importance. Notes on the color of the various parts are sometimes given with the description of the vessel. If not, one must apply the usual coloring for the period and nationality.

Ships up to the sixteenth century seem to have been largely of unpainted wood. Presumably they had unpainted, oiled upperworks and were tarred or oiled outside, with occasional touches of bright color, such as red wales, blue bulwarks, or painted shields hung along the pavisades. When religion was predominant, sacred devices were often painted on the sails.

Oak was, at that time, the favorite wood for shipbuilding, but oak is unnecessarily hard for model work and its grain is out of scale. A softer wood stained a not too dark oak color will represent it. Where a Stockholm tarred effect is wanted, diluted Brunswick black will give it exactly, or a mixture of mahogany and walnut stains can be used.

For painted surfaces of this period it is wise to keep to the earth colors, such as yellow ocher, light red, and cobalt.

Painting along the water line. A strip of decorator's masking tape or gummed paper is used to insure a perfectly true division

The underwater body was usually tallowed, and tallow is white. Blank white paint, however, would not look right, so I rub in some blue and green with my thumb at the bends, along the keel, and in similar places, and then wipe on some raw sienna.

Whether or not to antique ships of these and later periods is entirely a matter of preference. The ships were certainly not antique when they were sailing. Their paint was bright and their sails white. Nevertheless, I think that models of medieval vessels look more natural when judiciously antiqued.

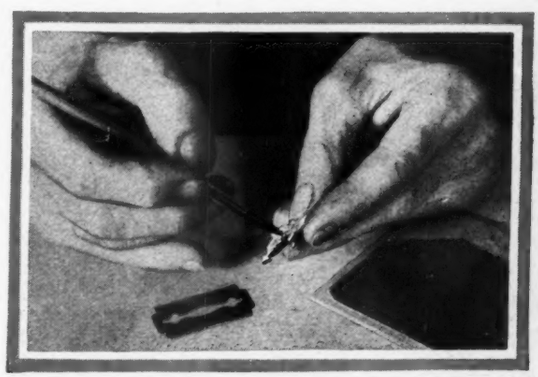
A little unevenness in the staining, with perhaps some darker brown rubbed in corners and on the undersides, will be sufficient. Raw sienna and Vandyke brown or burnt umber are the most useful antiquing colors.

The sails can be dipped in tea or coffee, but I find I get a better effect by painting them with very thin stain, perhaps adding a touch of color at the clews.

The masts of any period can be assumed to be one of the pitch pines (much like Oregon pine), which is of a burnt sienna color. I paint the spar with a thin coat of this transparent color, with just a touch of Vandyke. If it is large enough, I "comb" it down with a ragged brush to get the long grain effect, and then varnish it.

Ships of the late sixteenth, seventeenth, and eighteenth centuries were much the same but with a good deal more paintwork than their predecessors. The Elizabethan ships were especially gay, their fancy patterns giving way in time to red, black, yellow, and white stripes, with much light blue on Catholic ships. For these effects, instead of painting one coat directly on the raw wood, several ground coats should first be given.

Ships of the late eighteenth and nineteenth century period, including clipper ships, were painted all over, except for hardwood and rails, carved work, and the like. Even the masts (except between the doublings) were painted white, black, or some color. The underwater portion was by this time, however, covered with copper sheathing. Such ships *(Continued on page 90)*



Applying genuine gold leaf to the figurehead for a model of the galleon *Revenge*. The effect is better than gilt paint

Coming . . .

A Freighter Model

THESE authoritative instructions for painting ship models are published especially for the information of members of the Popular Science Model-of-the-Month Club, but will be found helpful by all ship model makers.

The next article in the Model-of-the-Month Club series will tell how to build a 14-in. model of a freighter.

Hot-Weather

TAKE YOUR CHOICE OF THESE ARE LOTS OF FUN TO MAKE AND

CELLULOID SILHOUETTES CUT FORTY AT A TIME

CUT in quantities from thin pieces of celluloid, silhouettes of the type illustrated above are quickly made and can be attached to cameras, automobile doors, books, camping and sporting equipment, and other possessions. The smallest size is suitable for use on personal stationery, and may be added as a finishing touch to many kinds of small novelties. The design shown is of a Boy Scout, but you may copy silhouettes of yourself and friends from profile snapshots or use innumerable varieties of decorative shapes.

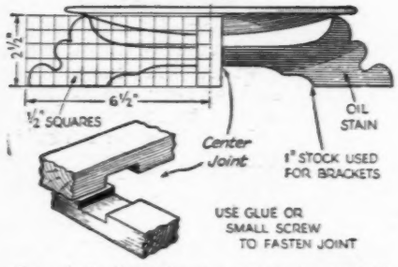
Up to forty small squares of automobile side-curtain celluloid or other thin celluloid are first made into a block by coating the edges with acetone, which, when dry, will hold them together. Draw the design on the top with India ink; then carefully cut it out on a scroll or jig saw with a fine blade, as shown in one of the photographs.

A built-up block of thin celluloid squares is sawed into silhouettes like those above

After separating the pieces, coat each silhouette, if transparent, with white or colored lacquer or enamel. To cement them securely to any smooth surface, merely coat the backs with acetone.—K. M.

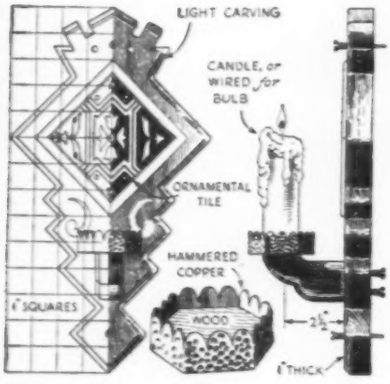
A GRACEFUL HOLDER FOR SHALLOW FLOWER BOWLS

BY RAISING a shallow flower bowl a few inches above the table, the blooms are set off to better advantage. A graceful holder for this purpose can be made in half an hour. Two pieces are cut as shown in the squared diagram below and joined in the center with a small screw or glue. Finish in a dark oil stain or in bright orange, blue, or green lacquer, if you prefer to use a solid color.



One of the flower-bowl supports in use and a drawing of the design, slightly modified

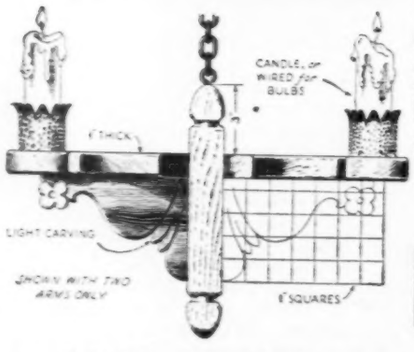
TWO ARTISTIC LIGHTING FIXTURES

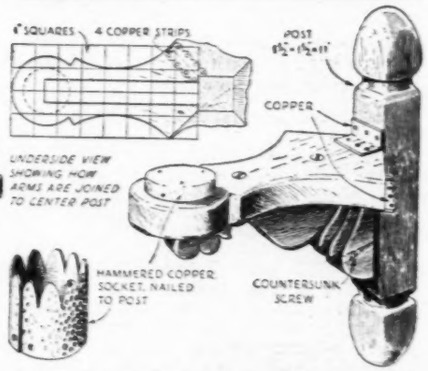


ALTHOUGH they are unusually decorative and original, these lighting fixtures in wood and copper are simple to make. They may be freely duplicated by any amateur craftsman through the courtesy of the designer, Durlin Brayton, an artist of Laguna Beach, Calif.

The hanging bracket will carry four chapel candles, or it can be wired for electric bulbs. It is an effective and appropriate fixture for beach cottage, cabin, or studio. Any wood of your selection will be satisfactory. Copper strips are used as shown to reënforce the fixture as well as ornament it.

Make the candle sockets of copper or brass, and fasten them to the wooden disks with escutcheon pins. Countersunk screws hold the brackets to the center post, and wood plugs are driven in over the screw heads. Finish with an oil stain, and apply rotten stone to give a gray, antique effect, but don't use any shellac or varnish.





The construction of the wall fixture is still simpler. Its unique feature is the ornamental tile in the back.—HI SIBLEY.

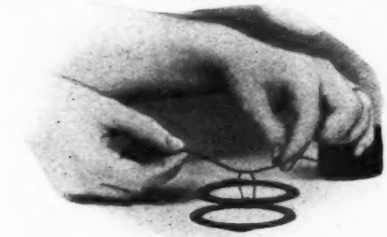
Craftwork

LIGHT NEW PROJECTS...THEY COST LITTLE FOR MATERIALS

OLD JAR RINGS USED AS SINK DRAIN-BOARD MAT

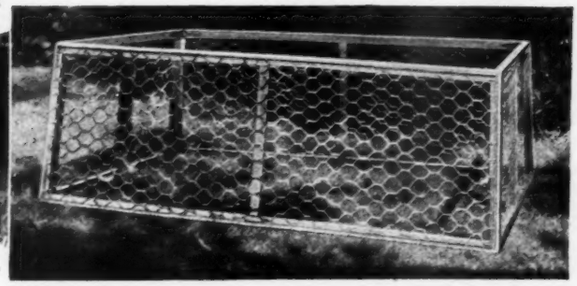
TO PROTECT a porcelain sink drain board or other highly polished surface from being scratched by dishes, pots and pans, and silverware, a rubber mat can quickly be made from discarded fruit jar rings as illustrated. It is also a safeguard against chipping china and glassware. The dishes, after being washed, can be placed on the mat and hot water poured over them. The water will run down under the rings into the sink, leaving the dishes so hot that they will require little, if any, wiping.

Cut the lips off as many rings as required and tie them together with smooth, strong string. Keep the work flat on a table so that the ties will all be on the same side. The finished mat can be folded over twice and hung on a hook. Smaller round mats may be made for use in the bottom of the sink or elsewhere.—ZEUS L. HURDLE.



Keep the rings flat on the table when tying them together, and use a regular square knot

Play pen folded up and, below, opened for use. The construction is shown in the drawings at the right. Note that there are no loose ends of wire to cause scratches



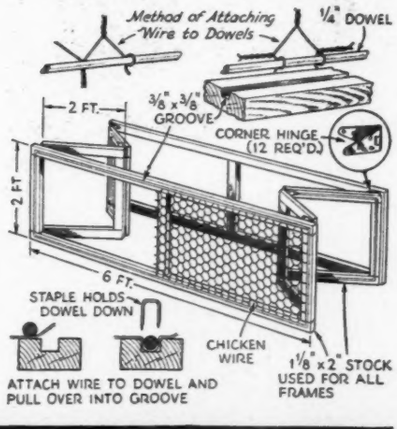
Children get great sport with this scooter, especially when coasting, because it twists and turns when least expected

ZIGZAG SCOOTER GIVES NEW THRILLS

BECAUSE it zigzags along the sidewalk with unexpected twists and turns, the three-wheeled scooter illustrated above gives a child more thrills than does the ordinary type. The rider may use a stick to guide it and change direction if it is used for coasting. Several zigzag scooters may be tied together to form a train; this provides great sport on a roped-off street or skating rink. Ordinarily, however, the scooters should not be used on the street because they are too erratic.—D.A.B.

SAFE WAY TO BUILD WIRE PLAY PEN

INCLOSURES are often needed to keep small children from straying away or to prevent puppies from wandering into neighboring back yards and arousing the ire of near-by residents. The quickest and least expensive way to make a suitable inclosure is, of course, to use chicken wire. The accompanying drawings show a method of fastening the mesh to the framework in such a way that there are no loose ends of wire to scratch the hands or get tangled in the clothing of any one either inside or outside the pen. The method can be used with any type of inclosure, but is shown in connection with a folding pen made to restrain a pair of lively dachshund pups.


Method of Attaching Wire to Dowels
1/4" DOWEL
2 FT.
3/8" x 3/8" GROOVE
CORNER HINGE (12 REQ'D.)
2 FT.
6 FT.
STAPLE HOLDS DOWEL DOWN
CHICKEN WIRE
1 1/8" x 2" STOCK USED FOR ALL FRAMES
ATTACH WIRE TO DOWEL AND PULL OVER INTO GROOVE

Four frames 2 ft. square were made for the ends, and also two frames 2 by 6 ft. for the sides, with stretchers at the middle of the latter. The stock was 1⅛ by 2 in., and mortise-and-tenon joints were used, since a mortiser was available. Before the frames were assembled, a ⅜ by ⅜-in. groove was run the length of each piece. A rabbet plane, router, or dado cutter on the saw table may be used for this operation.

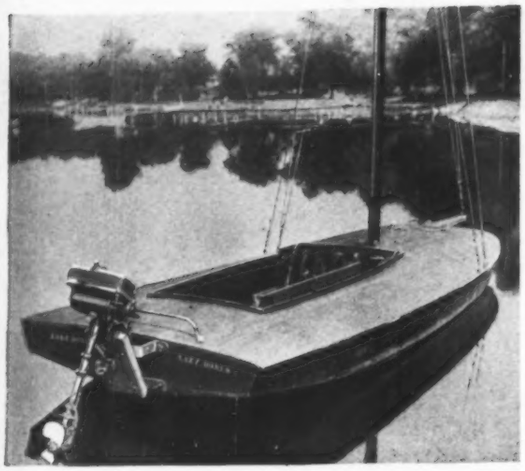
The frames were then assembled and the wire was cut for the panels, allowing a couple of inches waste on each side. Next, ¼-in. dowel rods were laid on top of the wire, which had been cut to expose either one or two wires. These were half-hitched around the dowel at every point. This brought the ends out toward the worker from the underside of the dowel. When one side had been thus attached to the dowels, they were pulled over and driven down into the groove, after any long wire ends had been cut off. The dowels were fastened with small staple at each point of attachment to the wire. This made a neat, taut, workmanlike job, without a single loose end of wire projecting anywhere.

The dimensions of the inclosure may be modified as desired, but those suggested are large enough for all ordinary purposes, and the height is sufficient to prevent most small dogs from making any attempt to jump out.—J. S. HAGANS.

DETACHABLE

Outboard-Motor Bracket

and other boating hints

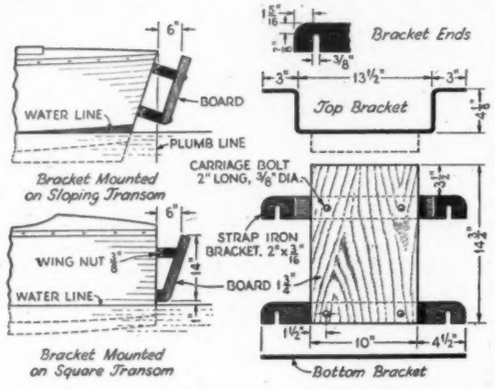


Sailboat with bracket for mounting an outboard motor. To remove both bracket and motor, it is necessary only to loosen four wing nuts. The construction, given in the drawings below, may be adapted to any boat

WITH a detachable motor board like that illustrated in the photograph above and the accompanying drawings, an outboard motor may be used to power a sailboat, inboard motor boat, or small cruiser in emergencies or when auxiliary power is required. The confidence of being able to get home without aid no matter what happens adds to the pleasure and security of cruising.

The construction is substantial, simple, and inexpensive. The board may be adapted to nearly any type of boat by altering the bottom bracket to suit the shape of the stern.

When not in use, the board is carried inside the boat. Between trips it may be attached to the boathouse wall so as to be removable, where it serves as a convenient motor rack. Rack and motor may then be instantly transferred to the boat.

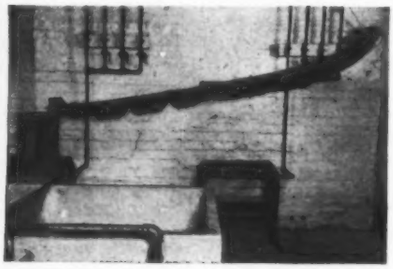


The board is a piece of oak or hard pine, 1¾ by 10 by 14¾ in. The 2 by 3/16-in. strap-iron brackets are drilled, slotted, and bent squarely as shown, and attached to the board with four 2 by ⅜-in. carriage bolts. The ends of the brackets may be fitted flat against a sloping transom by bending the ends in a vise to whatever angle may be required.

Be sure to provide the proper clearance between the water and the bottom edge of the board, as indicated in the drawings that show the board attached to the boat. For racing motors it may be necessary to make the board 12 in. high, although the dimensions given on the drawings will fit nearly all motors in common use.

Mark and bore the transom of the boat for ⅜-in. carriage bolts. They are placed with their threaded ends out. Provide bolts long enough so they will project 1 in. outside of the transom. After putting the ⅜-in. wing nuts on the bolts, batter the ends of the bolts slightly to prevent the loss of the nuts. In use, the bracket slots are slipped over carriage bolts, and the wing nuts turned down securely.

On boats with a rudder in the center of the transom, fasten the motor board to one side, so that it will be clear of the rudder.—WILLIAM JACKSON.



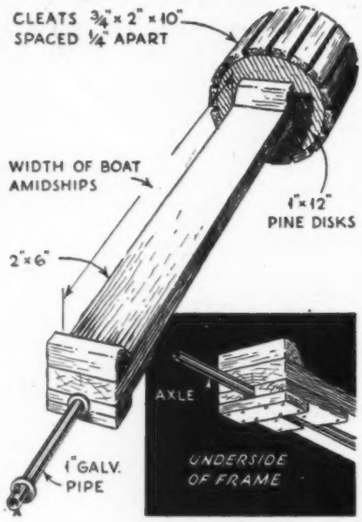
OLD INNER TUBES TAKE PLACE OF STEAM BOX

LONG strips of wood can be steamed for bending by incasing them in several old inner tubes as shown in the photograph above. In this instance a discarded oil can holds the boiling water, and the end of the nearest inner tube is tied securely over the spout.

This particular set-up was used for steaming the gaff of a new sailing rig made for the POPULAR SCIENCE MONTHLY kayak (Sept., Oct., Nov., and Dec. '32 issues).—CHARLES H. TAYLOR.

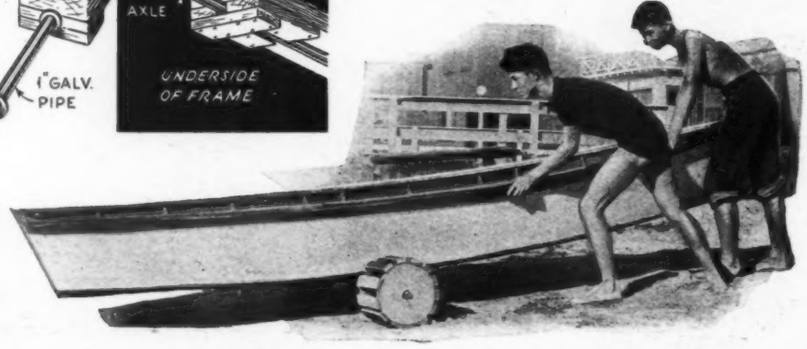
Another reader steamed the heavy frames of a 40-ft. cruiser in a somewhat similar manner in order to obtain a flare at the bow. A camp gasoline stove, an old metal map case, an inner tube, and string were used, with a wire hook to hold the stove to the shear plank just aft the frame to be bent.—THE EDITOR.

A LAUNCHING DOLLY FOR SMALL BOATS



THIS launching dolly, which can be adapted for use with round or V-bottom boats as well as with rowboats, makes it easy for one person to get a small boat in and out of the water without scraping the bottom. The wide tread of the rollers enables the dolly to run on soft or wet sand and gravel.

Make the cross-member assembly to fit the bottom of your boat about amidships, and secure a 1-in. or larger galvanized pipe axle to it by means of wooden blocks, as shown. For the roller disks, use 1 by 12-in. stock. The wooden cleats should be spaced about ¼ in. apart so that water will drain out quickly to relieve the weight when beaching the boat.—HI SIBLEY, JR.



For information about our blueprints, turn to page 80.

HINTS ON MAKING *Novel Costume Jewelry* FROM SHEET CELLULOID

By Kenneth Murray

VERY little skill is required for making attractive costume jewelry from sheet celluloid. Because of the handwork involved, each piece has a value and appearance that takes it entirely out of the ten-cent-store class.

Celluloid in dozens of patterns and colors can be obtained from dealers, or you can buy cheap celluloid articles and cut them up to supply material. It is a simple matter, if you prefer, to prepare suitable stock in any thickness by building up pieces of auto side-curtain celluloid, cementing and coloring it as described in a previous article (P.S.M., May '35, p. 112).

Cut the celluloid to shape with a hand scroll saw, or if you use a power saw, run it at low speed and use a fine blade. The teeth can be cleaned by taking a cut in a piece of wood. Small wood gouges and gravers may be used for carving, but with a little practice you can get almost as good results with the sharp point of a small knife. If you have a hand power grinding tool, like the one shown in Fig. 3, it can be used with small dentists' burs for rough cutting and removing waste.

The imitation cameo in Fig. 2 was cut from a piece of cream-colored celluloid in a mottled pattern. Mark the outline and main parts of the design with black wax crayon or a marking pencil; or sand the glossy surface and use an ordinary pencil. Start with the parts in greatest relief, gradually scraping away the background and leaving the finest details to the last. The completed cameo is cemented with acetone to a backing piece of celluloid (in this instance, coral colored). It can be mounted as a pin or for use as a button, or a small one can be used for the top of a celluloid ring.

The earring at the right of the cameo in Fig. 2 was made in the same manner from jade celluloid. Fine detail was not carved in these pieces because of the difficulty of reproduction; most jade pieces, however, contain more or less fine detail in the form of carved flowers, leaves, and stems. A study of commercial pieces in jewelry-store windows or jewelry catalogues will be found helpful.

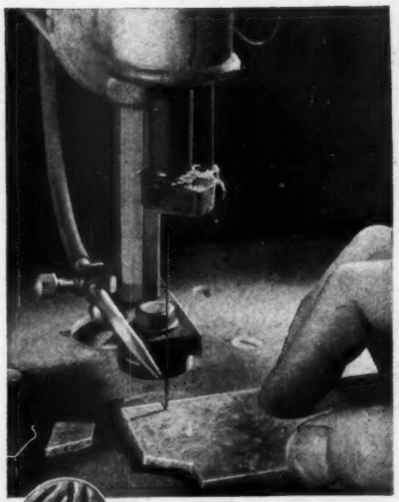


Fig. 1. If a power saw is used to cut celluloid, raise the hold-down and keep the celluloid moving so that it will not stick

Fig. 2. A celluloid cameo and earring. The first is cream celluloid mounted on a coral-colored piece; the second is jade celluloid. The necessary attachments can be taken from ten-cent jewelry

Fig. 3. Carving a cameo with the aid of a magnifying glass. A scraping cut is best for beginners, but after some practice a shaving stroke may be used

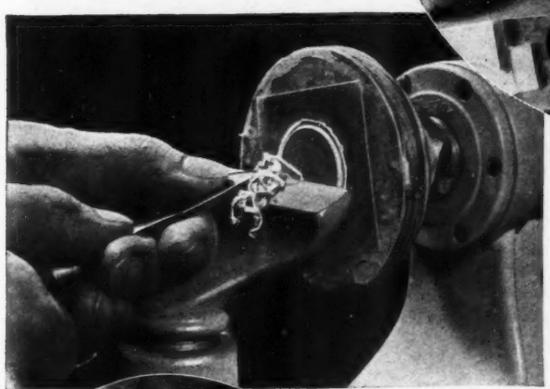


Fig. 4 (below). Mounting a photograph in a recess turned in a celluloid button. The picture is then covered with a disk of thin, transparent celluloid cemented at the edges with acetone

Fig. 5. To turn celluloid, cement a piece of thin celluloid to the faceplate and attach the work with several small dabs of acetone. Wood-turning tools are employed

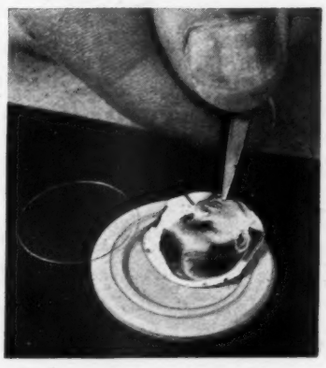


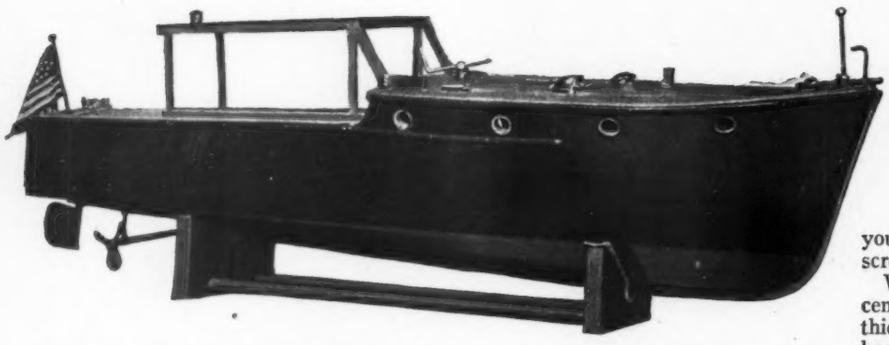
Fig. 6. Cementing a small lingerie pin to the back of the bar pin with acetone. A small block of celluloid is required in attaching the pin

Initials for the bar pin shown at the top of the page were cut from white celluloid and shaped with small files after the necessary holes had been drilled. They were then cemented to a black background piece. The background may be carved or otherwise ornamented, if desired. A small lingerie pin is attached to the back as shown in Fig. 6.

A novel button is illustrated at the left of the completed bar pin. Part of a snapshot is used for the decoration. Buttons can be quickly turned on a lathe, if available, or cut to any shape with a scroll saw. In the present example, the center was partially removed and the snapshot inserted, as shown in Fig. 4. The picture was then covered with a disk of clear celluloid, which was cemented at the edges with acetone.

After each piece of costume jewelry is completed, finish any rough edges with a file and then use fine sandpaper to obtain a smooth, satin apearance. The original gloss can be restored by flowing with acetone. While the acetone is wet, you can, if you wish, lightly dust on a little bronze powder of any color.

PLANKING OUR NEW Motor-Boat Model



Framed and planked motor-boat cruiser model. It is 30 in. long and driven by a spring motor

E. F. WALDRON

explains a remarkably easy method . . . It can be used for many other types of boats

THOSE readers who are building our new 30-in. cruiser model (P.S.M., Aug. '35, p. 62) should have the framework assembled by this time, ready for the planking. If you missed last month's issue, you will see from the photograph above what the boat is like. The method of construction is unique because the ordinary difficulties of making a framed and planked model have been almost entirely eliminated. Even boys can build the model successfully.

Bottom Planking. Turn frame over, bottom up. Block up stern so boat is level. The garboard plank at keel is the first. Put plenty of celluloid cement on keel, on each rib for about 1 in. from the keel, and on edge of lower stem piece. Tack a plank at stern with pins (these will be pulled out later). Let plank take its natural position, and tack it to each rib with pins, working from stern forward until near the stem. Here a pin will not hold, therefore bore a hole in the plank and a smaller one in the lower stem, insert a ½-in. screw with a washer under its head, and screw it down until the plank is in place. On this one plank, you will need two or three more screws a little farther back, say on ribs Nos. 3 and 4, to pull the plank down to the keel. The plank will run up over the keel towards the bow because the keel is curved. Trim the plank to center of keel as in Fig. 1, and trim off the end to curve of bow. Now put on other garboard plank. Trim off part that overhangs keel as before so the two pieces meet at center of keel. Put on other bottom boards. At front they will separate slightly, but these gaps can be filled with tapered slivers planed to fit and stuck in with cement. Fasten bottom planks to stern ribs, and to the chine at bow. When bottom is all planked and cement dry, remove pins and screws at chines. Now trim and plane down plank edges flush with chine.

Side Planking. It is much easier to plank from stern toward bow, although contrary to common practice on large boats. On sides, you will find it simpler to plank from deck line to chine rather than up from chine to sheer. Fit each side plank by scribing it in. That is, after the first plank is fitted, the next plank is held nearly in place by clamps or screws with washers (Fig. 2). A line is then drawn on the new plank with a compass set to equal the widest gap between the planks. The compass is drawn along with the pointed end touching the edge of the plank already fastened on. The clamped-on plank is then removed and trimmed. It will fit perfectly. Continue planking, first a plank on one side, then a plank on the other. You can hold these planks with pins until nearly to the bow. For the last two or three ribs and stem, you may need screws with washers under them to hold down the planks while the cement is drying. Wherever pins do not hold the planks in place, use screws with washers under them. Do not hesitate to use screws; if you bore holes in planks and ribs, the screws will not split the wood.

When all planks are on, thin out some cement with acetone to half its original thickness and paint the entire inside of the boat two coats, allowing the cement to run into all corners and seams freely. You may then be sure of a water-tight boat.

Trim up the sides at front, at chines, and at tops of ribs. Sandpaper off the front edge, and fit and glue on the outside stem and outside keel (Fig. 3). The outside stem is made of square pieces as shown. The outer keel is a ¼-in. square piece glued and bradded outside the planking and over the inside keel. When cement is dry, whittle outside stem to shape, and remove all screws and pins. Plug screw holes with pegs whittled from same wood as planking and driven in with glue. Sandpaper hull smooth. Between stations 8 and 9 cut a curve for the drop of the raised deck as shown in the side view last month.

Motor. Obtain a five-minute spring motor. Locate it so that the winding shaft, when extended, will come up through the raised deck. The extension is shown in Fig. 4. Measure length of shaft needed and tubing for shaft sleeve. Approximate lengths are: Shaft 10 in., shaft tube 9 in. At one end of shaft tube, solder piece of 6-32 threaded brass rod at right angles to tubing, for a strut. Fill each end of tube with solder, and drill out to exact size of shaft. Bore holes *(Continued on page 84)*

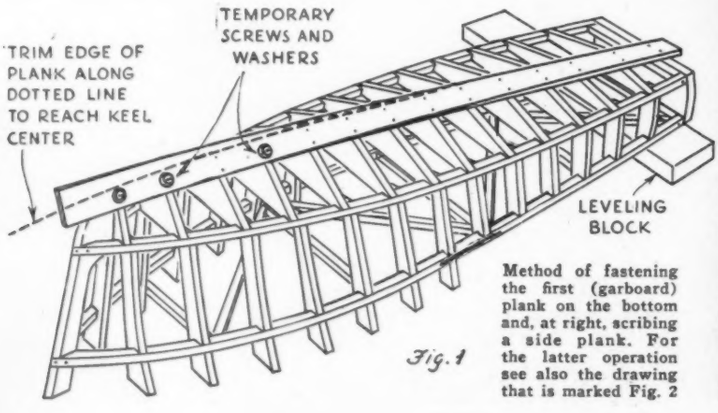


Fig. 1

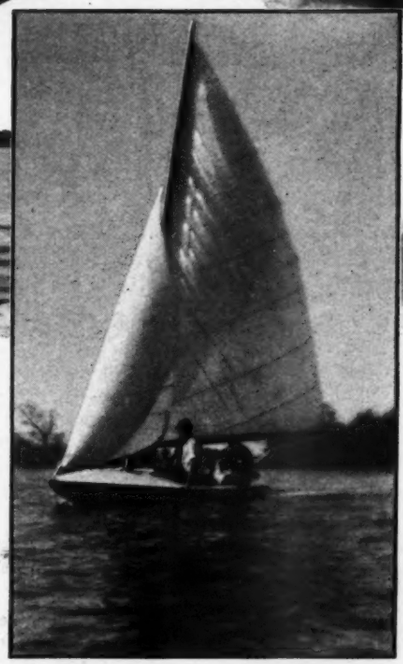
Method of fastening the first (garboard) plank on the bottom and, at right, scribing a side plank. For the latter operation see also the drawing that is marked Fig. 2

What Readers Are Making

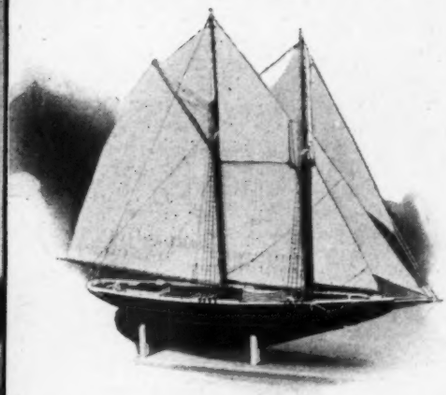
Model of whaling ship *Wanderer* made from *Popular Science Monthly* blueprints by Harry Bohec, of Rutherford, N. J. The hull is 20½ in. long

Playhouse by Harry M. Ringer, of South Connellsville, Pa. It is 7 by 7 ft. and 7 ft. high

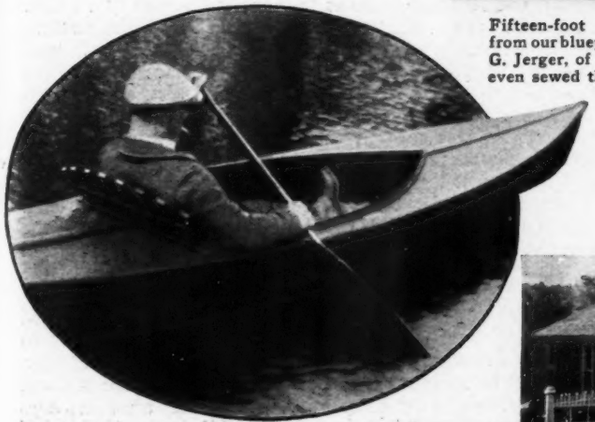
Speed boat *Coalite II* built by H. Abraham, of Whitbank, Transvaal, South Africa, from our plans. In two seasons he won seven cups and numerous other first prizes, and in one regatta, four out of five races. He knows of only one faster boat in South Africa, and that is lighter and uses a much more powerful motor



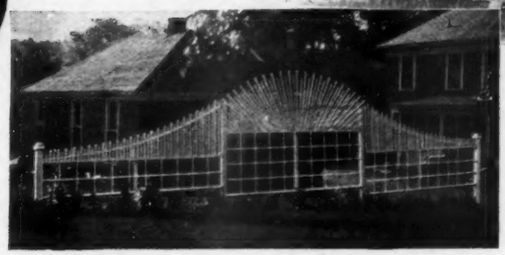
Fifteen-foot sailboat built from our blueprints by Harold G. Jerger, of Jasper, Ind. He even sewed the sails himself



Model of fishing schooner *Bluenose* made from our plans by W. A. McLean, of Hamilton, Ont., Canada



When Harry Reid, Woonsocket, R. I., saw our plans for a 16-ft. kayak, he built a 4-ft. model of it and later made the full-size canoe. He says it's "great for speed"



Large toy locomotive for a garden railway built by E. J. Marquart, of Auburn, N. Y. He also made the trellis with fan center shown at left

Small Water-Power Plants

By HAROLD P. STRAND

Fig. 1. General view of a plant that supplies current for lighting a house and outbuildings, for heating brooder houses, and for running small motors. The dam is built of timber and stone; the flume is of wood and 25 ft. long, its purpose being to increase the drop to the lower water level

Fig. 2. Homemade spillway for carrying off excess water. The logs are notched at the ends to form locked joints for added strength. An embankment of stone has been built to form strong retaining sides for the pond

Fig. 3. View over top of dam showing entrance to overflow. The top of the dam slopes towards the water; for this reason the first line of the planking has to be made shorter than the rear line of planks by about 2 ft. Stones are packed into every crack and crevice between the logs

ELECTRICITY for light, heat, and power can easily be generated if you happen to have a suitable stream or river running through your property and are willing to invest a reasonable amount of time and money in the construction of a small hydroelectric plant.

The stream should have a fairly steady supply of water running at all times of the year, and a spot should be chosen for the erection of the plant in which a good head and fall can be obtained. Many streams take a downward slope in their course at some point. By building a dam there, a pond will be created with a water level several feet higher than the lower level. This fall is what all water wheels depend on for their power.

Figure 1 shows a plant built on a western Massachusetts farm under conditions similar to those described above. The stream had a good sloping course, and the result of damming it and building a long flume gave a total head and fall of 12 ft., measured in a vertical line at the position of the water wheel from the level of the headwater to the level of the water in the tailrace.

The dam was constructed by taking 2-in. oak planks, cutting off one end of each plank at an angle of 45 deg., and driving them down in the ground as spiling in the form of two lines about 10 ft. apart so as to reach from one shore to the side of the flume. Each plank was placed with the straight side against the previous plank so the beveled end would tend to drive the planks closely together. The space between the lines of spiling was filled with stones and dirt, and tamped down very hard. On the outside top edge of each plank line, a heavy log was secured with bolts, and across these logs other logs were placed at right angles to them. Planking was laid on the last logs.

The flume is about 4 ft. wide, 7 ft. deep, and 25 ft. long. The framework was built of 4 by 4-in. oak, lockjointed at the corners. The planking is oak with splined edges. Heavy field stones were used in the form of a wall on both sides of the dam for further reënforcement.

The building, 10 by 12 ft., is constructed entirely of wood and has three windows and a door. It is built closely up to the end of the flume. Note the draft tube, 22 in. in diameter, extending below the floor of the building. This tube is about 8 ft. long. While draft tubes for special cases are sometimes made from 20 to 25 ft. long or possibly longer, it is good practice to limit their length to 10 or 12 ft. The lower end of the tube must always be under water, and the tube itself

Produce Cheap Electricity

Suggestions for constructing a dam, flume, and spillway . . . Equipment needed . . . Various methods of automatic control

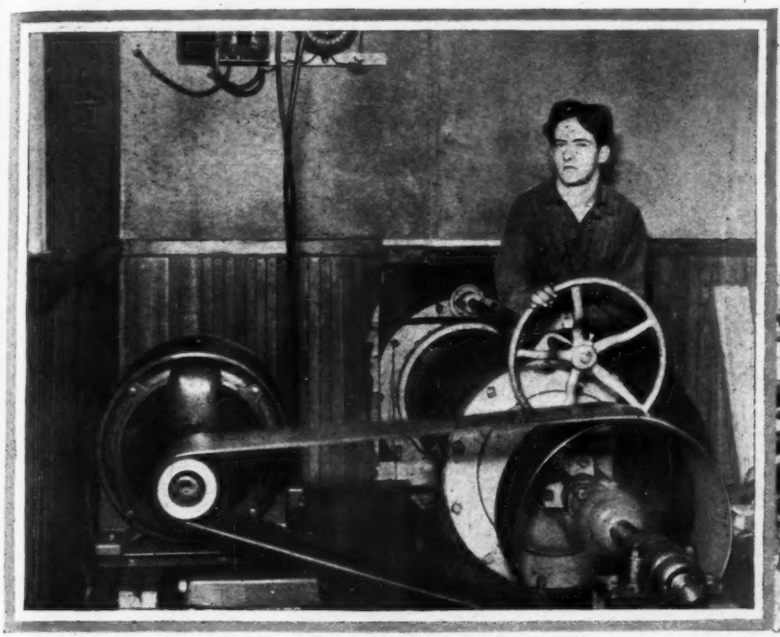


Fig. 4 (at right). Entrance to flume. Note slope of dam and stones at side of pond. Fig. 5 (above). Russell E. Webster, builder and owner of plant, at handwheel controlling gates. The flange of the draft chest is bolted to oak planking at end of flume

should be made air-tight for efficient operation.

In many cases before attempting to construct a dam, a spillway must first be built to divert the water so it will not hamper operations on the dam. This overflow is permanently used as a means of keeping just the right level of water in the flume by allowing all excess amount to flow over the edge of the fall. Such a spillway is shown in Fig. 2. Heavy logs cut in the woods form the material for the framing, and 2-in. planking lines the inside surfaces. It is built high to allow for any debris or drift matter to pass under, as well as to allow for high water seasons.

A view over the top of the dam and showing part of the pond and the entrance to the spillway is given in Fig. 3. Its relative position to the dam can be noted.

Figure 4 shows the entrance to the flume with its grating, known as the "rack," so placed as to keep out any matter that might get into the waterwheel gates and cause trouble. When this view was taken, the flume was not quite completed. The wooden sides extend down 3½ or 4 ft. under the water level, so the flume has about that much water for a head.

In Fig. 5 is the interior of the power station with its owner and builder seated on the draft chest. The turbine is a horizontal type with a 15-in. runner wheel operating at a speed of 300 r.p.m. The flange of the turbine is bolted to the end of the wooden flume with stout machine bolts. Its speed is regulated within certain limits by the handwheel, which operates the gates. The generator is a 110-volt D.C., compound-wound motor (7½-h.p.), giving about 6 kw. As the drive must be short, a form is employed that utilizes the weight of the motor to keep the belt tight; this is made possible by a sort of hinged joint at the base.

The electrical connections consist of No. 1 rubber-covered wire coming from the generator to the 60-ampere inclosed switch on the wall. Beside the switch is the field rheostat used to vary the voltage. One side of the *(Continued on page 89)*

Fig. 6. River plant with concrete flume and a natural earth and rock dam, grown over with grass sod. It develops 25 kilovolt-amperes A. C. and 8 kilowatts D. C.—sufficient current for a nearby factory as well as ordinary domestic lighting service

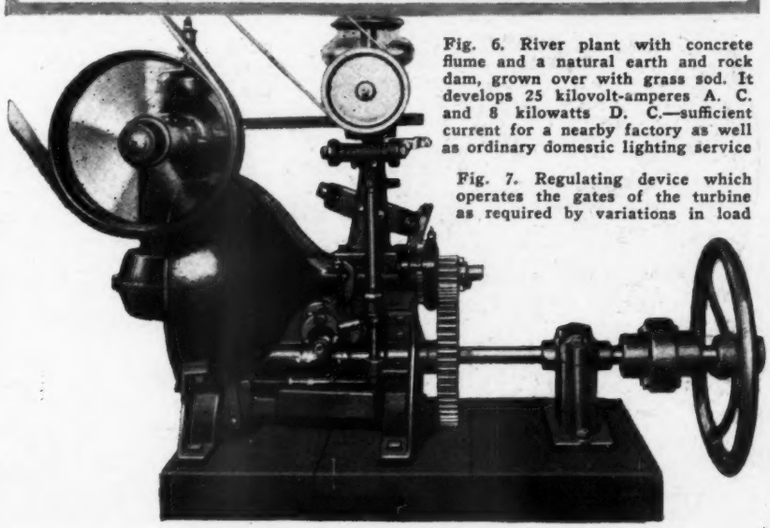
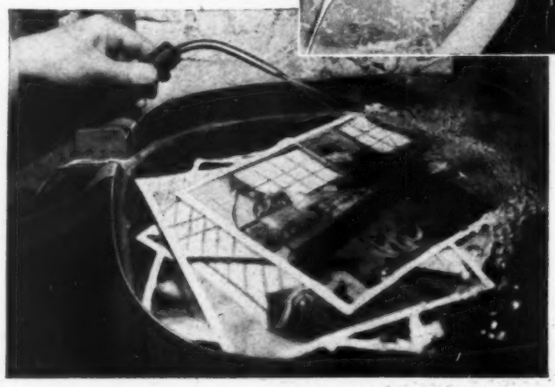


Fig. 7. Regulating device which operates the gates of the turbine as required by variations in load

Washing PHOTOGRAPHS

Foolproof ways to remove every trace of hypo from both films and paper

By FREDERICK D. RYDER, JR.



Homemade monel-metal tank for washing prints that costs less and is better than commercial galvanized-iron tanks. At left, the flattened copper nozzle has been lifted to show the velocity of the stream

BARTON was completely disgusted. And I didn't blame him.

"Just look at these prints," he gloomed, thumbing over page after page of the album of pictures he'd taken on a long vacation trip a couple of years ago. "The worst of it is," he went on, "when I looked up the negatives to have a new set of prints made, I found them all discolored and spotted, too. What the dickens is the matter?"

"Did you develop and print 'em yourself?" I asked.

"I did a few rolls myself. The rest I had done at a photo finisher who quoted me a low price. What I can't understand is why the same trouble should show up in both cases."

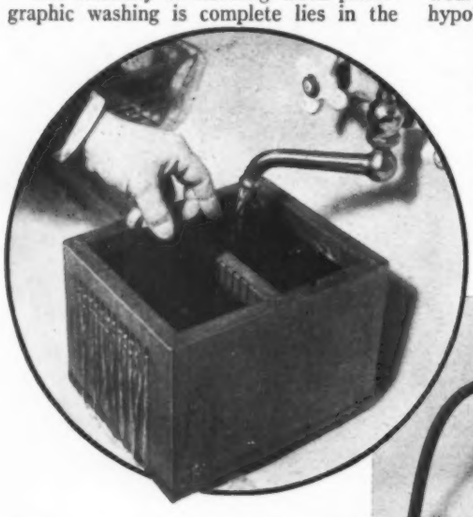
It didn't take a photographic Sherlock Holmes to spot what was wrong. When a photographic negative develops brown crystalline discolorations or prints and enlargements take on a faded, streaky, yellowish brown tone, you can bet the trouble is the result of insufficient washing. What happens is that the hyposulphite of soda from the fixing bath, which is left by inadequate washing, in time reacts with the black silver deposit to form sulphur compounds of silver, and these are brown or yellow in color. If, in addition to inadequate washing, the negative or print is fixed in a bath that is almost exhausted, the discoloration will appear sooner and stronger.

The difficulty in knowing when photographic washing is complete lies in the fact that there is no outward and visible evidence to show when the job is done. The brown stains, even with quick and careless washing, rarely show up in less than six months or a year. If you do your own developing and printing, you will never encounter this trouble once you learn how to do a thorough washing job.

A fresh fixing bath will remove all the yellow color in a very few minutes. It would seem logical to assume that if the hypo can penetrate through the gelatin in that short time, it should dissolve out in the wash water in an equally short time. However, we have to take into account the chemical affinity between hypo and silver bromide or chloride, which undoubtedly speeds up the penetration, whereas the hypo, being already dissolved in water, has no similar strong chemical urge to mix with more water. In fact, the only reason you can wash the hypo out of the pores of the gelatin at all is because all salt solutions have a natural tendency to equalize and become uniform throughout when a strong solution comes in contact with a weak one or with plain water.

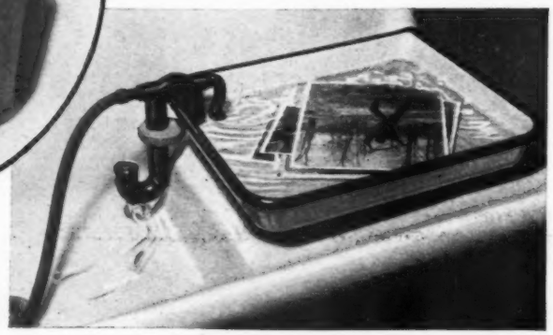
Removing the fixing salt solution from the gelatin, then, means diluting it out of the pores by keeping the gelatin continually in contact with water containing less salts than that held by the liquid already in the gelatin. It has been found that with the average film with which you take snapshots, the hypo can be satisfactorily removed in from seven to ten minutes if the film surface is held directly in the flow of water from a faucet. Under the same conditions, a lantern slide plate, which has a very thin emulsion, will be washed in one and a half to two minutes. At least half of the hypo is removed in the first minute of washing, the rate of removal slowing down as the bulk of the unwanted salt percolates out.

Because the gelatin coating on printing and enlarging paper is much thinner than that on negative film, it would seem at first glance that washing prints should be a speedy operation. It is not, however, because the paper stock also is porous and is filled with hypo solution, whereas the celluloid film base is impervious to it. The shortest wash for any single weight print or enlargement should be about twenty-five minutes under ideal washing conditions, and for double-weight paper an hour is about the minimum. *(Continued on page 86)*



An easily made but efficient wooden wash box for cut films or plates. If desired, the center partition can be made movable so that two or more sizes may be washed. The partition has holes near the bottom

The use of a tray siphon for washing prints is shown below. The hose is fastened to a faucet, and the siphon hooked over the tray



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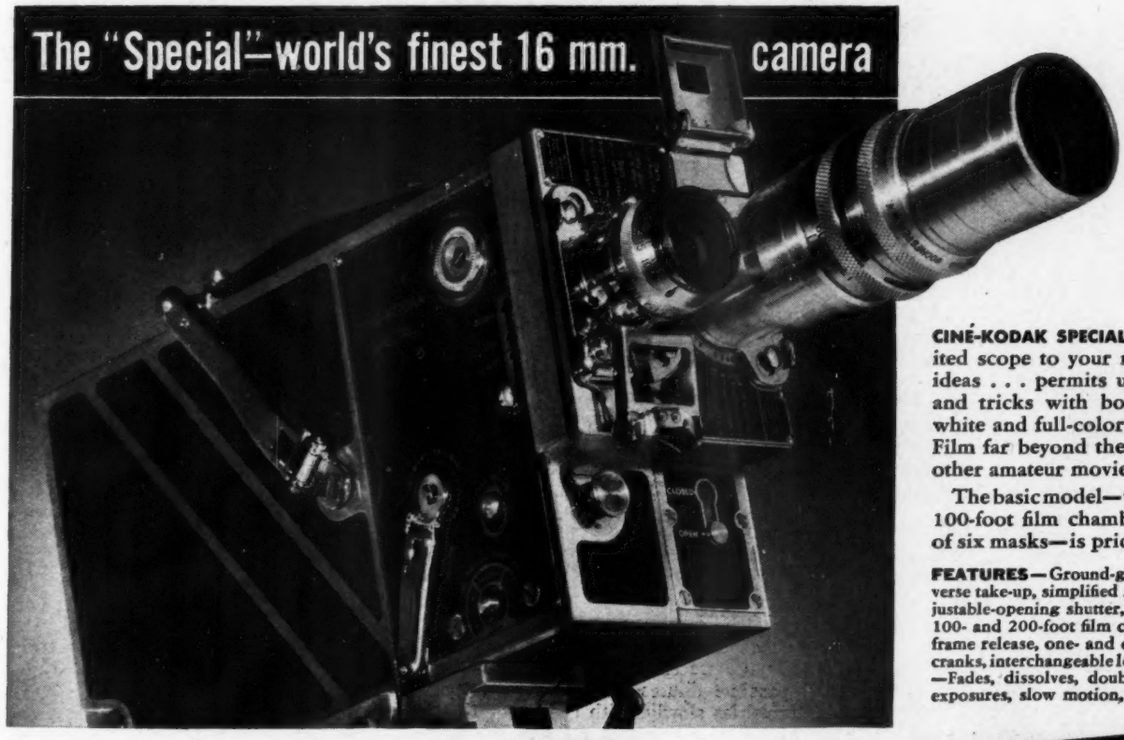

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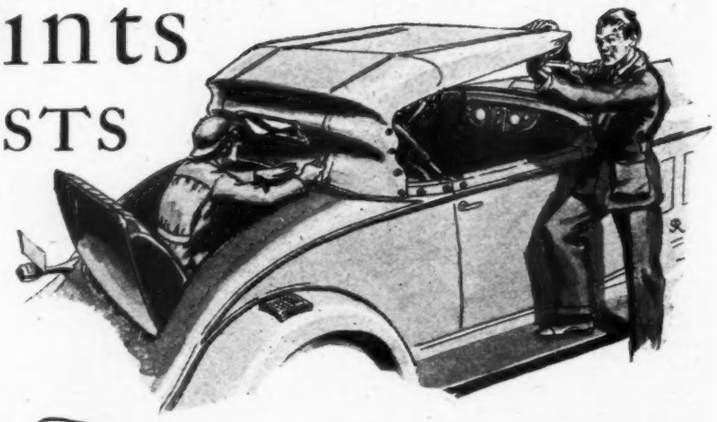
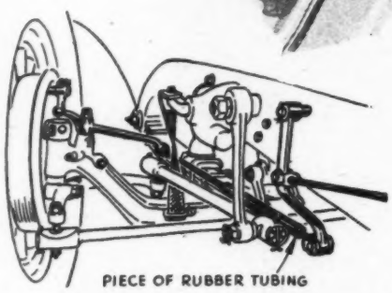
P. S.-9-35

Helpful Hints FOR MOTORISTS

These Suggestions From Auto-Owning Readers May Save You Time and Money



OFTEN on roadsters it is difficult to fasten the bottom edge of the rear, fold-up curtain. Rain shrinks the material and, in shortening, the flap becomes a tight fit. By following a simple kink, however, the curtain can be fastened easily and quickly. Simply loosen the corner-post thumbscrews and lift the front edge of the top a few inches. The slack provided will allow the rear-flap fasteners to be snapped into place. Then, by the application of a little pressure, the corners of the top may be refastened to the corner posts.—D. L. C.



How rubber tubing can be applied to front-wheel brake rods to stop annoying rattles

Stops Brake-Rod Rattle

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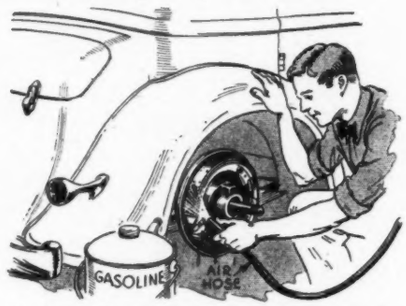

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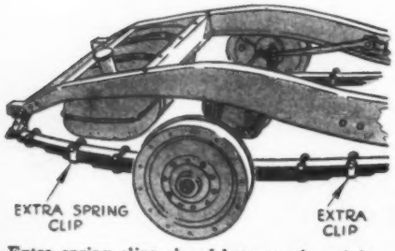

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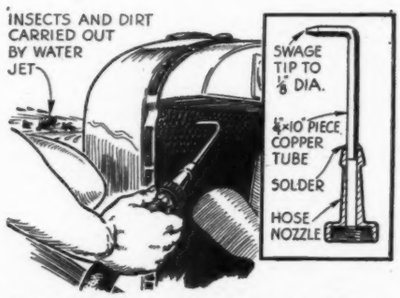

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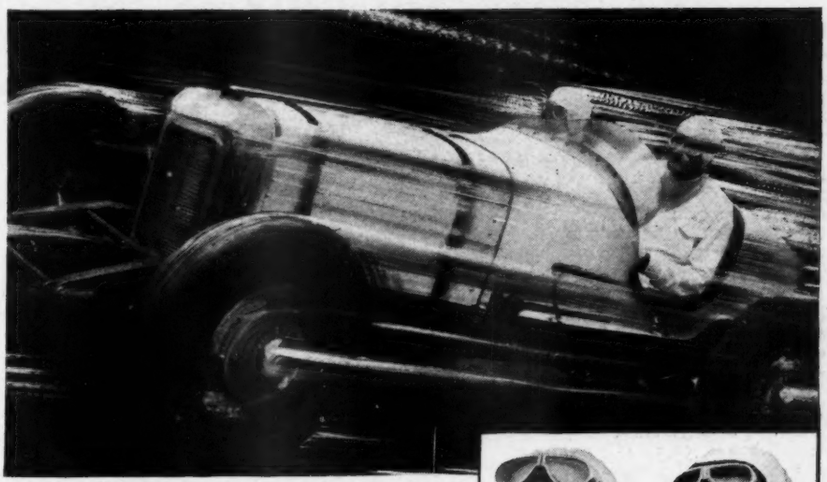

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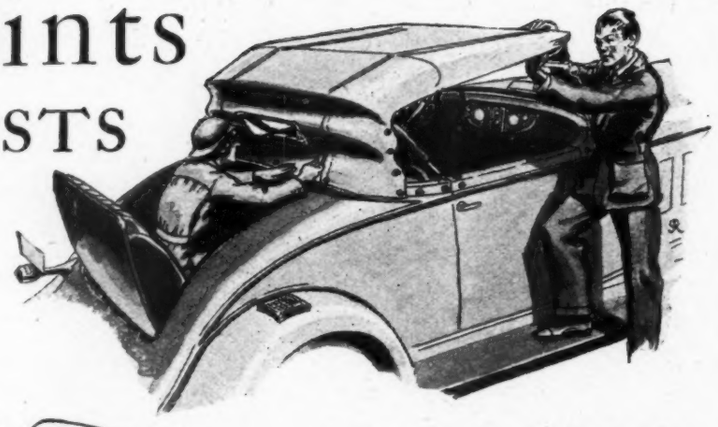
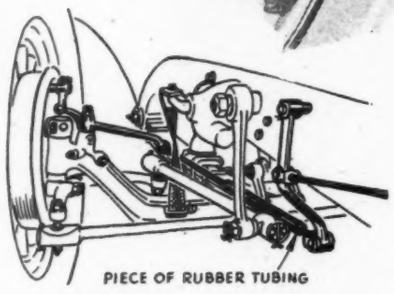
Please mention POPULAR SCIENCE MONTHLY *when answering advertisements in this magazine.*

Helpful Hints FOR MOTORISTS

These Suggestions From Auto-Owning Readers May Save You Time and Money



OFTEN on roadsters it is difficult to fasten the bottom edge of the rear, fold-up curtain. Rain shrinks the material and, in shortening, the flap becomes a tight fit. By following a simple kink, however, the curtain can be fastened easily and quickly. Simply loosen the corner-post thumbscrews and lift the front edge of the top a few inches. The slack provided will allow the rear-flap fasteners to be snapped into place. Then, by the application of a little pressure, the corners of the top may be refastened to the corner posts.—D. L. C.



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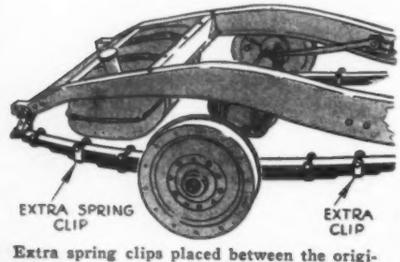

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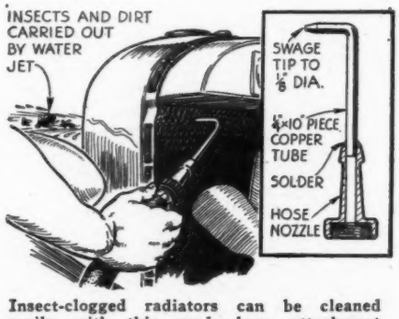

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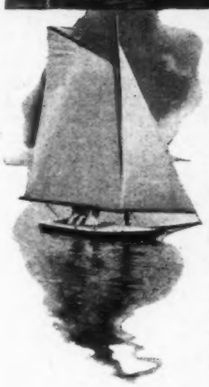

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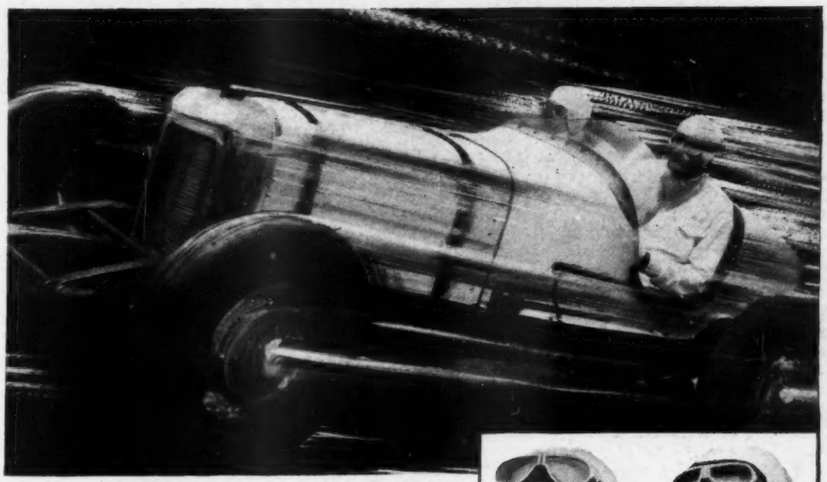

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SIMPLIFIED
Venetian Blinds

Add a Luxurious Touch to Any House

By W. K. MOSS

FOR rooms exposed to direct sunlight, the construction and installation of Venetian blinds will prove a valuable addition to any home.

They do not interfere with ventilation through a room as ordinary roller shades do; they can be adjusted to deflect the sun's rays upward, outward, or inward; or they can be pulled into a compact parcel under the top casing.

Venetian blinds can be purchased at most window-curtain shops. After constructing these shades for twelve windows in my own home, I can appreciate the reason for the high price of commercial shades, yet any man with time on his hands and a little patience will find the job interesting and the expense nominal. The principal item is labor.

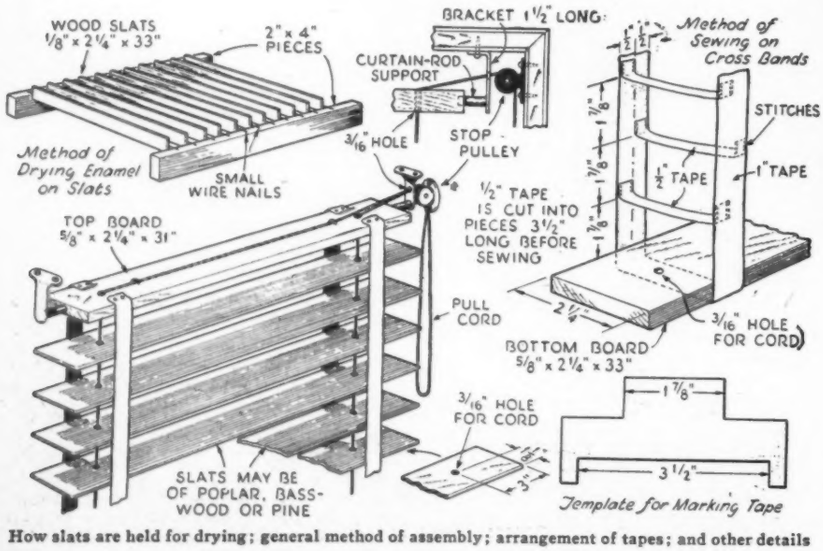
Sunlight partially deflected by homemade Venetian blinds

You will need a quantity of ½- and 1-in. linen tape; cord for raising and lowering the blinds; a pair of curtain-rod holders to serve as the pivot bearings, and a pair of elbow brackets for supports and friction adjustments. Cord holders can be devised in many ways, but probably the most economical is the use of spring curtain-rod supports, the clips being bent out slightly to furnish a grip on the cord when under tension. "Stop pulleys," however, may be purchased which bind the cord. Estimates for the number of wooden slats can be figured from the list on the following page.

It is of prime importance that your blind stock be perfectly straight. Basswood, poplar, or pine may be used, but it should be resawed before it is kiln-dried, then dressed and sanded. Wood that has been kiln-dried before being sawed into strips will usually warp. Old birch, which has had plenty of air-drying, may be resawed satisfactorily as a general rule. To prevent later chipping of the enamel, all edges of the slats should be carefully sanded round.

Now paint the slats with the best quality of undercoater and enamel (to avoid blistering in the hot sun). All painting should be done before the strips are bored to eliminate paint "runs," and the pieces set aside to dry as shown.

Cut the 1-in. linen tape into pairs of the required length for each window, leaving a little surplus at the ends to be tacked out of sight on the upper side of the toppiece. At the exact center of the tapes, mark off a section in pencil 3⅝-in. wide (the bottom wood piece is later tacked here). Commencing each way from these two marks, pencil a line every 1⅞ in. for each cross tape, and an extra space as a marker for the toppiece. Now mark the ½-in. tape into 3½-in. sections and make a pencil mark ½ in. inside the ends of these sections as guides for the sewing. Then cut this tape into 3½-in. sections, which are the cross-pieces between the loop of the 1-in. tapes. The tapes can be easily marked if they are thumb-tacked to a drawing board and a template is used such as that illustrated.



How slats are held for drying; general method of assembly; arrangement of tapes; and other details

List of Materials

For average window with inside casement measuring 34 by 52 in.

No. of Pieces	Description	Dimensions
1	Toppiece	⅝ by 2¼ by 31 in.
1	Bottom piece	⅝ by 2¼ by 33 in.
24	Slats	⅛ by 2¼ by 33 in.
1	Pair curtain-rod supports and brackets. Brackets to be	1½ in. long
2	Linen tape	1 in. wide, each 100 in. long
48	Linen tape	½ in. wide, each 3½ in. long
1	Nontwisting curtain cord	130 in. long
1	Stop pulley or small pulley and cord holder	

Undercoater and enamel, best grade
Upholstery tacks (1 package)
Approximate cost, $1.30 to $1.50.

On the sewing machine sew one end of each 3½-in. section (laying each small piece of tape in the same direction) onto the 1-in. tape, every alternate crossband being on the opposite edge of the wider tape. Leave the last mark and the two center marks unsewed. Then fold the other end of the 1-in. tape over and sew the loose ends of the cross-bands to it at the respective pencil marks, being sure that each is on the proper edge and lies in the opposite direction from the first sewed end. When completed, you should have a loop, open at the top end, and held together by crossbands 1⅞ in. apart. Tie the ends of the sewing thread in a double knot to prevent pulling out.

The wooden toppiece should be cut 2 in. shorter than the balance of the blind to allow for the hardware. After the painting has been done, attach the curtain-rod holders to the ends of these pieces.

Now take the brackets and carefully mold their rod supports around the rod holders so that they will fit tightly; this provides for friction adjustments later. Be sure the brackets are sufficiently long, at least 1½ in., or you will not be able to close the blinds entirely. Close to the elbow of the right-hand bracket, near the top of the free side, drill a 3/16-in. hole to guide the cord into the pulley, and file the edges smooth.

Any adjustment of light may be obtained by raising, lowering, and tilting these blinds

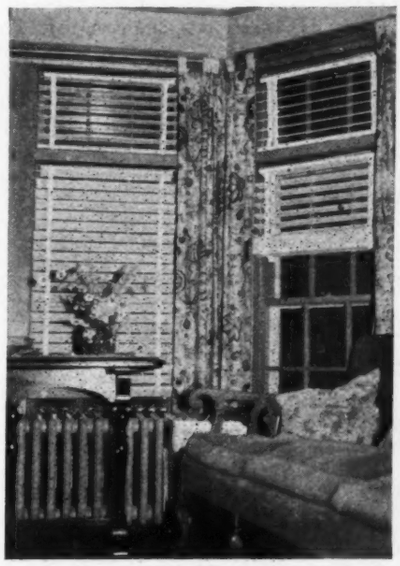
The next step is boring of the stock for the cord controls. In commercial blinds, it should be noted, the cords pass through slots 3/16 by 1 in. or larger. These are to allow the slats to be turned to a nearly *(Continued on page 75)*

VENETIAN BLINDS

(Continued from page 74)

vertical position. I have found, however, that plain holes are quite satisfactory. Carefully match the required number of slats and two end pieces edgewise and lengthwise, and bore a 3/16-in. hole through the entire set approximately 3 in. from each end and 1⅛ in. from each edge. Enlarge the holes on the underside of the bottom piece to a depth of ¼ in. to enable countersinking the knotted end of the control cord. The edges of the holes on the upper side of the toppiece should be chiseled down and sanded to prevent excessive wear.

Tack the open ends of the tape loops to the upper side of the toppiece from opposite sides, centering on the bored holes but not overlapping them. Somewhere in your shop set up two hooks from which to hang this preliminary assembly. Insert the bottom piece and



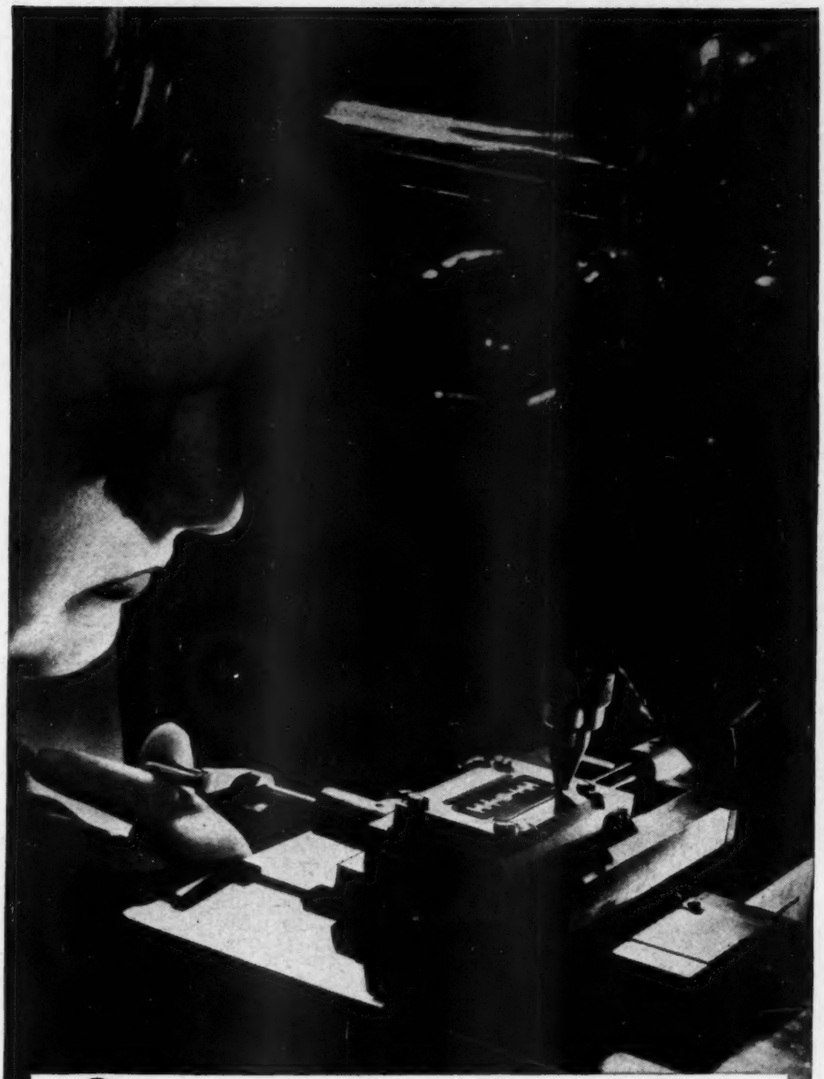
Variously adjusted blinds. They give better ventilation than ordinary roller shades

center it between the first two pencil marks. Now insert your slats across each crossband.

Feed both ends of the control cord up through the pulley and through the hole in the bracket; then thread each end separately downward through the two holes in the toppiece. It will be easier to do this if you bind the two ends of the cord with thread to prevent unraveling. Feed the cord ends directly down through the middle of the slats and alternately on the inside of one cross tape and the outside of the next one, continuing through the bottom piece. This will hold the slats in their proper positions without side slip. If desired, the ends of the cord may be slipped through ordinary shirt buttons and knotted, or large knots may be tied in the ends to prevent them from pulling back through the bottom piece. After the cord controls have been put in place and the buttons countersunk, tack the bottom piece in place with white upholstery tacks.

Slip the brackets on the curtain-rod supports and screw them to the underside of the top section of the window casing, keeping the blinds flush with the front edge of the casing. Install the pulley in the corner of the right-hand casing, centered on the hole in the bracket. If a stop pulley is not used, a cord holder must be mounted on the inside of the casing below the pulley near the bottom of the window. Pull the two cords through the pulley and catch them in the holder.

These blinds are of the simplest construction and therefore must be adjusted to the desired angle by grasping the bottom piece.



Diamonds **MEASURE THE HARDNESS OF GILLETTE STEEL**

HAVEN'T you often noticed that even in the *same package* of ordinary blades—one blade may give you a decent shave—while others pull and scrape? Lack of uniformity begins with the steel itself. In the finest coil of steel, hardness varies. This is why diamonds—rare and costly—80 times harder than any other substance in the world—test the temper of Gillette steel after heat treatment in furnaces exclusive with this company.

Every minute of every working day samples of steel from the furnaces are submitted to the hardness tester pictured above. Here a square cut diamond—pressed against the steel—measures hardness with absolute accuracy. Variations of more than 1½% from the desired standard result in rejection of the steel.

Here's one reason why you get a far better shave every time you put a Gillette "Blue Blade" to your face. Its edges are *uniformly* keen because ground on steel of correct temper—hard enough to cut glass, yet tough and resilient for long life. Try the Gillette "Blue Blade" and see for yourself. Ask your dealer for a package tonight.

Reputable merchants give you what you ask for. In stores where substitution is practised—INSIST ON

GILLETTE BLUE BLADES
NOW 5 for 25¢ · 10 for 49¢

WRITES J. W. MOORE FROM ENGLAND

I have always hoped that somewhere there might be a vintage tobacco, to be approached with reverence, like a rare wine.

My quest is ended

Along a path remembered by many a burnt tongue and countless half used packages thrown away.

Virginia sent us our first tobacco—

and now she sends me my only *tobacco,* **EDGEWORTH.** *Long may you flourish and continue the good work. Surely this is the "pursuit of happiness," nay, the attaining of it!*

Yours faithfully,
J. W. Moore

Harton, South Shields
England

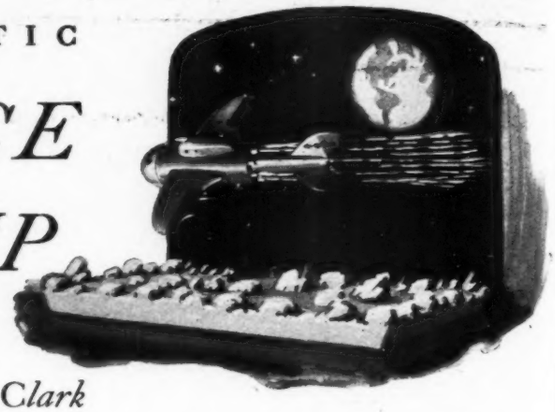
BUY A TIN of Edgeworth today and discover why Mr. Moore searched all England to find "vintage tobacco" before he finally turned to Edgeworth and found the smoking pleasure he had been yearning for. You will agree with him! Larus & Brother Company, Richmond, Va. Tobacconists since 1877.

On your radio, tune in on WRVA, the Edgeworth Tobacco Station, 1110 Kilocycles.

FUTURISTIC

SPACE SHIP

MODEL



By Donald W. Clark

BECAUSE of the interest shown by readers in the rocket-plane model previously described in this series (P.S.M., Apr. '34, p. 67) and the general popularity of imaginary interplanetary aircraft, we are giving the plans for a new rocket plane or space ship as the June project in the Popular Science Model-of-the-Month Club.

This odd-looking craft was designed as simply as possible so that it might be duplicated by readers without requiring too much time or trouble. It has twenty-five parts, not counting the fastening pins.

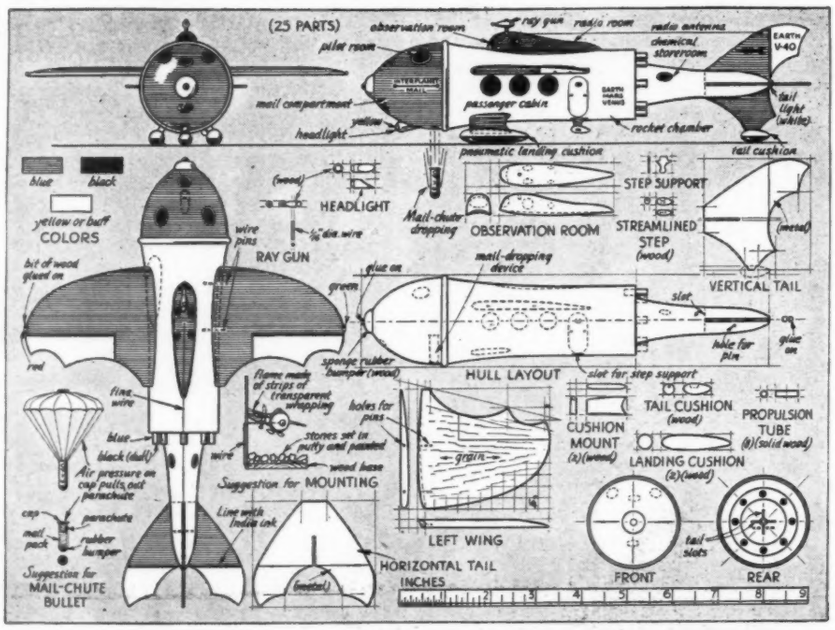
At the present time, rocket planes are undergoing intensive experimentation in Germany, and also in this country, at Cleveland, Ohio. In England, a rocket-propelled mail projectile is being tried out. In the future—how far distant no one can guess—space ships will probably be seen arriving and departing at our modern airports, and people will take as little note of them as they do of the big air liners that pass over cities every day.

The present model is similar in construction to the earlier rocket plane in the series. If no lathe is at hand, it is not difficult to cut out the hull from pine or balsa wood. An easy way to shape rounded parts uniformly, without using templates, is to hold the work under a bright light and turn it slowly. Any irregularities can be spotted and corrected with sandpaper. When completely shaped, mark the location of all of the parts that are to be glued or pinned in place. This will save time when assembling. Use a metal point to roughen all surfaces to which glue is to be applied.

Make paper patterns for marking the wings and tail units.

Your model will be a treat to the eye if painted according to the color chart given. After priming the wood with nitrate dope (model airplane dope), give entire surface a coat of yellow enamel. When dry, use light blue on those portions shaded to indicate blue. Use black for windows, rocket-tube ends, landing cushions, door outline, and identification markings. If you like, you can then mount the model against a painted background showing distant planets.

Here are all the simple parts of the space-ship model. At top of page, model in its setting



This drawing gives top, end, and side views of the model, and details of its parts. Note the suggestion for mounting in a realistic setting as shown in the picture at the top of the page

MARBLE GAME PLAYED LIKE BASEBALL

(Continued from page 57)

behind the cardboards. This board and the pieces that are above the top holes serve to conceal the movements of the one dropping the marbles. Paint the insides of the top holes black so shadows will not reveal the position of the marbles when no cardboard is used.

One player drops the marbles, and the other operates the levers. You can play it using either one or two levers, but two levers are preferred.

If the marble enters the hole, it is a "strike" on the one operating the levers. If he prevents it from entering, he scores a "hit." When he makes three strikes in a row, he is "out" and the players change places. Play any number of "innings" agreed, and the one scoring the most hits wins. The game should be played with the "time interval" adjusted so there will not be too many hits, or so that it will be too easy to strike a player out. One way to play is to use no cardboard for the first inning, and then starting with the narrowest, increase the width each inning until all are used.

The player dropping the marbles must drop them accurately. They must enter the hole to count a "strike." If a marble bounces out after entering the hole, it is counted a "strike," but the padding in the box that catches the marbles should be soft enough to avoid this.

If you care to complicate the game a little, consider it a "hit" only when the marble does not roll off onto the table. If it bounces off or is knocked off, call it a "foul" and count the fouls the same as in baseball—that is, for the first two strikes, but not for a third strike. A third strike must enter the hole.

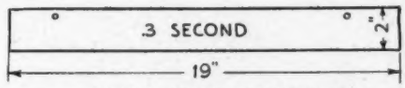
To test for reaction time, use at first only two of the four holes and one lever. (For some tests later on you can, however, use both levers and the inside holes, or both levers and both holes.) Start with the narrowest cardboard or none at all. Allow a little practice so the one being tested may become acquainted with the device. A good way to do this is to give tests with groups of ten trials until there is no increase in the person's ability. Then proceed with tests at shorter time intervals until he fails to make a score of about 7 out of 10. You may consider the shortest time interval where a score of about 7 out of 10 is made as the reaction time of that person. When the marbles are dropped during a test, don't try to outguess the one at the lever. Make a list of the order for dropping in the various holes and follow it regardless of how the one being tested is moving the lever.

You will find that many people can react rather consistently in .25 of a second, but .20 of a second is usually too short.

This is actually not a simple reaction time test because when either two or four holes are used, a decision must be made as to which way to move the lever; and when four holes are used, a decision must also be made as to which hand to move. The test, however, is more practical than a simple reaction test because most of our daily reactions involve a choice between alternatives.

If you have a good reaction time, it does not necessarily follow that you will make a good automobile driver, but any one who reacts considerably slower than the average should be very cautious about getting into situations where quick action is required.

It is interesting to note that people differ considerably in their reaction time and also



—MAKE FOUR OTHERS—

4¼"	WIDE — MARK IT	.25	SECOND
5½"	"	"	.23	"
7"	"	"	.21	"
7¾"	"	"	.20	"

Dimensions of the five cardboard shields

that children are not as quick to respond as adults. Another curious fact is that practice, up to a certain point, improves your quickness, but after that even a great deal of practice has no effect.

Alcohol combined with motoring provides a problem that centers around the question of reaction time. It has been shown experimentally that even small quantities of alcohol cause a slight slowing of reaction time. And not a great deal is required until the delay in response of the driver may mean the difference between life and death. The best brakes are useless if their application is delayed. Reaction time is, indeed, an important factor in high-speed travel of all kinds.

If you wish to calculate the width of other cardboards for other time intervals, subtract the time interval desired from .40 of a second (the total fall of the marble) and use the resulting time to calculate the width of the cardboard thus:

Width of cardboard in feet=16 times (time in seconds)²

Example: To get time interval of .25 of a second, .40 minus .25 gives .15. This number squared is .0225, and multiplied by 16 gives .36 of a foot, or approximately 4¼ in. This is the width of the cardboard that will give a time interval of .25 of a second.

1

Ingram's softens every whisker right down to the skin line

2

Tightens the skin; prepares it for easy, scuffless shaving

3

Cools the shave; prevents burning and after-shave soreness

Ingram's cooler shaves explained by ... 3 COLD FACTS

The cool shaves men get with Ingram's are due to three special ingredients which help shavers these three ways—

1st, whiskers are thoroughly wilted but held erect for clean once-over shaving. 2nd, skin is smoothed and lubricated so your razor can glide in long, even strokes. 3rd, the shave is cooled; no stinging or smarting.

Ingram's makes shaves so soothing you'll never need a lotion. And because it is *concentrated* it will make your shaves cost less! Three months of happy shaving from each tube or jar.

TRY THE WORLD'S COOLEST SHAVE *free*

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I'm in favor of better shaves! Send me the free 10-day tube of Ingram's.

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Street_____

City_____ State_____

INGRAM'S SHAVING CREAM

UNRULY HAIR

Stays Neatly Combed

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—a bottle lasts for months

IS YOUR HAIR difficult to keep in place? Does it lack natural gloss and lustre?

It is very easy to give your hair that rich, glossy and orderly appearance so essential to well-groomed boys.

Just rub a little Glostora through your hair once or twice a week — or after shampooing, and your hair will then stay, each day, just as you comb it.

Glostora softens the hair and makes it pliable. Then, even stubborn hair will stay in place of its own accord.

It gives your hair that natural, rich, well-groomed effect, instead of leaving it stiff and artificial looking as waxy pastes and creams do.

Glostora also keeps the scalp soft, and the hair healthy by restoring the natural oils from which the hair derives its health, life, gloss and lustre.

Try it! See how easy it is to keep your hair combed any style you like, whether parted on the side, in the center, or brushed straight back.

A large bottle of Glostora costs but a trifle at any drug store and will last for months.

Glostora

Window display of Topeka, Kans., club showing the entries it sent to the National Exhibition

WHAT'S NEW AMONG the GUILD CLUBS

Official Magazine POPULAR SCIENCE MONTHLY

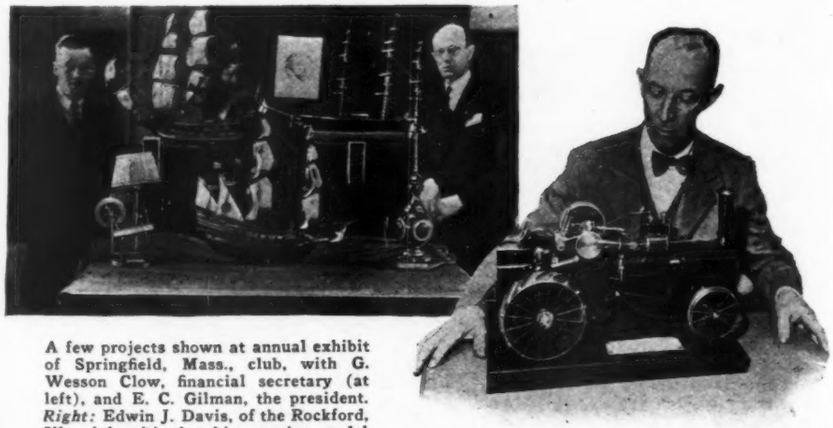
THE secret of conducting a successful home workshop club is rapidly being learned by the officers of the 179 clubs now affiliated with the National Homeworkshop Guild.

An excellent example of what can be done by enthusiasm and skillful leadership is to be found in the history of the Chicago Premier Homeworkshop Club. It was organized April 23, 1934, with five members and since then has grown to be one of the largest clubs in the Guild. Under the guidance of Earl G. Peek, president, and Alexander Maxwell, secretary, it carried off the grand sweepstake prize at the National Guild Exhibition with a score of 22 points. Mr. Maxwell gives some helpful clues as to how this club is conducted.

"Running a club," he writes, "is easy. It can all be summed up in two sentences: Make the fellows want what you have to give them, or find out what the men desire and see that they get it. Dictatorship doesn't work. Formality is frequently a handicap. A man can be led much faster than he can be shoved. Don't argue with any one, and don't let any one else start a controversy. Change the subject the moment a sore spot is touched.

"Don't build up a huge cash reserve. Don't charge dues to a man who is not present. Collect dues at every meeting, if only a nickel. No come, no cost!

"Make every man understand that it is his club and his opinion is important. Make them talk. Ask every man pointed questions so that he has to say something. As soon as he gets

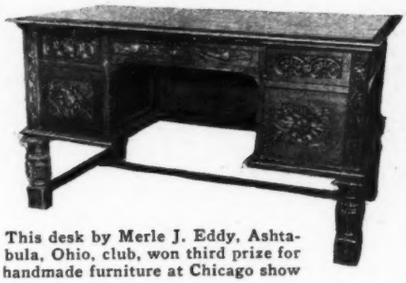


A few projects shown at annual exhibit of Springfield, Mass., club, with G. Wesson Clow, financial secretary (at left), and E. C. Gilman, the president. *Right:* Edwin J. Davis, of the Rockford, Ill., club with threshing engine model

over being afraid of his voice, he will liven up. A powwow is more successful than a monologue. It gives everybody a satisfied feeling, and when the time comes to pull together, friction will be minimized. Each man will have already expressed his opinion, so he can be counted on with less inducement. This method has worked out well in Chicago. It might be a flop in Squash Center or Hoboken, but I doubt it."

Billings (Mont.) Homeworkshop Club. A baseball game, archery meet, and fly-rod casting contest were features of the club's summer picnic. Many of the members have made their own archery equipment.

Richmond (Ind.) Homecraft Club. Meetings will be resumed September 2. The club



This desk by Merle J. Eddy, Ashtabula, Ohio, club, won third prize for handmade furniture at Chicago show

now has a membership of thirty-five. Among the occupations represented are medicine, dentistry, radio, printing, selling, and cabinetmaking. So much work was turned out by the members in their home shops the past year that an exhibition held just before the summer recess required a showroom 50 ft. wide and 125 ft. long. Robert A. Chattin is president; Harry Moss, vice-president, and Jack Reed, secretary-treasurer.

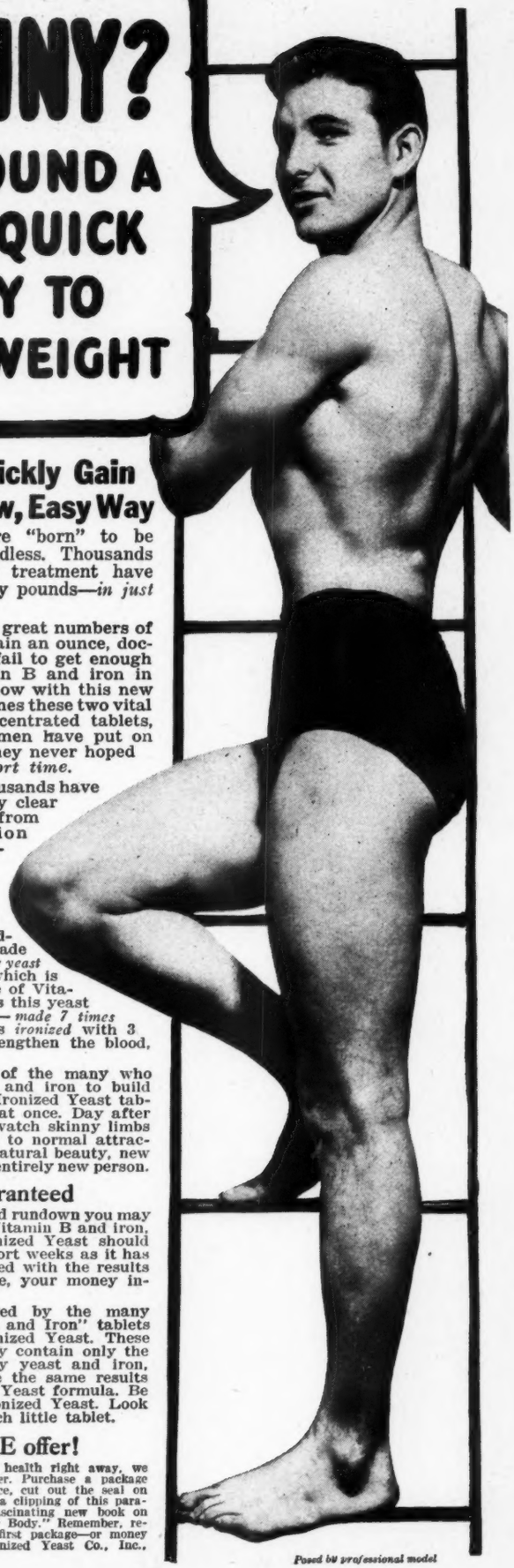
Wood-Ridge (N. J.) Homeworkshop Club. The organization of a junior auxiliary for boys of from fourteen to eighteen is on the proposed program for the 1935-1936 season. Other activities on the schedule are Christmas toy making on the same extensive basis as last year; a trip to the New York City plant of a large dealer in veneers and fancy woods; and a visit to a Hackensack, N. J., department store for a special demonstration of machine tools. At the regular club meetings, there will be the usual miscellaneous demonstrations, and at the weekly informal meetings the members will work on individual and club projects. The annual election of officers will take place in December, and the second exhibition will be held in the spring of next year. Prizes will be awarded as usual for the best manual training work done in the public schools. C. D. Chase is president, and G. N. Schalk, secretary.

Miami (Fla.) Homecraft Guild. Plans for the fall activities of this newly organized club, the first of its kind to be established in Miami, are being made by the officers, James M. Elliott, president; Seymour Brandes, vice president; Will Smith, secretary, and Royce Chalmers, treasurer. Among the programs already given before the club were a lecture on design by Chester M. Davidson, a high school instructor of industrial arts; a demonstration of woodworking machines; a talk on the "Romance of Wood," by Mr. Brandes; and an exhibition of 100 samples of exotic woods collected by E. L. Crum.

Capital Homecraft Club, Washington, D. C. The club's first public exhibition was held this summer in the display windows of the Canadian Pacific Railway. . . . L. J. Kistler recently demonstrated a midget universal wood and metal working machine especially designed for ship model makers. H. E. Middleton, president of the club, gave a talk on wood carving.

Tucson (Ariz.) Homeworkshop Guild. The monthly club bulletin is so packed with interesting accounts of the weekly meetings and other information *(Continued on page 81)*

SKINNY? I'VE FOUND A NEW QUICK WAY TO GAIN WEIGHT



Thousands Quickly Gain 5 to 15 lbs. New, Easy Way

DON'T think you're "born" to be skinny and friendless. Thousands with this new, easy treatment have gained normally husky pounds—*in just a few weeks!*

The real reason why great numbers of people can't seem to gain an ounce, doctors now say, is they fail to get enough health-building Vitamin B and iron in their daily food. But now with this new discovery which combines these two vital elements in little concentrated tablets, hosts of men and women have put on pounds of firm flesh they never hoped to gain—*in a very short time.*

Not only that but thousands have also gained a naturally clear complexion, freedom from miserable indigestion and constipation, glorious new pep.

7 times more powerful

This amazing new product, Ironized Yeast, is made from specially cultured *ale yeast* imported from Europe, which is the richest known source of Vitamin B. By a new process this yeast is concentrated 7 times — *made 7 times more powerful.* Then it is *ironized* with 3 kinds of iron which strengthen the blood, add wonderful energy.

If you, too, are one of the many who simply need Vitamin B and iron to build them up, get these new Ironized Yeast tablets from your druggist at once. Day after day, as you take them, watch skinny limbs and flat chest round out to normal attractiveness. Skin clears to natural beauty, new health comes—you're an entirely new person.

Results guaranteed

No matter how skinny and rundown you may be from lack of enough Vitamin B and iron, this marvelous new Ironized Yeast should build you up in a few short weeks as it has thousands. If not delighted with the results of the very first package, your money instantly refunded.

Only don't be deceived by the many cheaply prepared "Yeast and Iron" tablets sold in imitation of Ironized Yeast. These cheap counterfeits usually contain only the lowest grade of ordinary yeast and iron, and cannot possibly give the same results as the scientific Ironized Yeast formula. Be sure you get genuine Ironized Yeast. Look for "IY" stamped on each little tablet.

Special FREE offer!

To start you building up your health right away, we make this absolutely FREE offer. Purchase a package of Ironized Yeast tablets at once, cut out the seal on the box and mail it to us with a clipping of this paragraph. We will send you a fascinating new book on health, "New Facts About Your Body." Remember, results guaranteed with the very first package—or money refunded. At all druggists. Ironized Yeast Co., Inc., Dept. 459, Atlanta, Ga.

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Mail us the coupon below for free sample of Genuine Masonite Tempered PRESDWOOD to experiment with in your own shop, and for additional literature.

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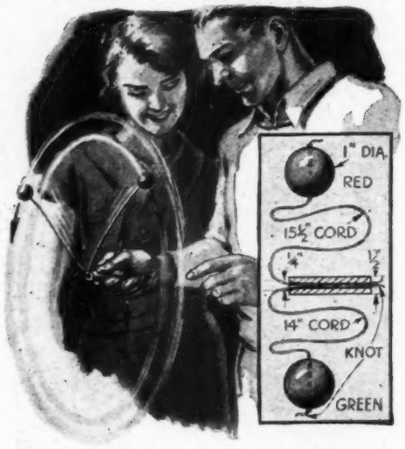
WHIRLING-BALL TOY TESTS DEXTERITY

A WHIRLING toy that will give hours of amusement can be made in a few minutes. It consists of two 1-in. wooden balls, one painted red and the other green, and both drilled so that a cord can be run through them. The cord for one ball is 14 in. long and for the other, 15½ in. The ends of the cord are passed through a cylinder of wood about ½ in. in diameter and 2 or 3 in. long. The hole through the cylinder should be just large enough to take the two cords, but at one end the hole should be enlarged to a diameter of ¼ in. and sanded to a very smooth finish. The cords are passed through from this end and knotted at the other end as shown in the accompanying diagram.

Spin the ball on the shorter string in one direction very slowly. Then attempt to start the other ball whirling in the opposite direction. After a little practice, you will be able to make the balls rotate at high speed in opposite directions, forming a pleasing blur of color.—H.



SELECTED BLUEPRINTS FOR YOUR SHOP

NOTHING will go farther to insure your success in making projects at home than to work from reliable blueprints. Here is a selected list of the famous POPULAR SCIENCE MONTHLY blueprints. If you do not find what you want, send a self-addressed, stamped envelope for our complete list.

RADIO SETS

All-Wave Portable (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Amplifier, Three-Stage Audio-Frequency, *42*	.25
Five-Tube Short Wave (A.C. or D.C.) *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

BOATS

*Canoe, 16-ft. Canvas Covered Kayak, with sail, etc., *192-193-194-R*	1.00
*Duck Boat, Folding, *170-R*	.50
High-Speed Boat for Small Outboard Motors (7 ft. 11 in. long), *257*	.25
*Outboard Racer, 10½-ft., 114 lb., *211-212-R*	.75
*Combination Sailboat and Motor Boat (15 ft., cat rig), *131-132-133-R*	1.00
Marconi Rig with Jib for Above, *133-A*	.25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224-R*	.50
*13-ft. Racing Runabout, *261-262-R*	.75

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

SHIP AND COACH MODELS

(Construction kits are available for some of these models. See page 88.)

Aircraft Carrier—U.S.S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in.), *226-227-R*	.75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Civil War Ships *Monitor, Merrimac,* and *Hartford* (3⅛, 5⅜, and 5⅛ in. long respectively), *258*	.25
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper, Simplified (9¼-in. hull), *219*	.25
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Brooklyn* (8-in.), *236*	.25
Cruiser *Tuscaloosa* (11¾-in.), *234*	.25
Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (33¾-in. hull), special prints *221-222-R*	1.50
H. M. S. *Bounty* (8½-in. hull), *254*	.25
Mayflower (17¼-in. hull), *83-84-85-R*	1.00
Motor Boat, 29-in. Cruiser, *63-64-R*	.75
Motor Boat, Working Model (20-in.), *196*	.25
Liner—*Aquitania* (9-in.), *225*	.25
Liner—*California* (12½-in.), *251*	.25
Liner—*Normandie* (20⅝-in.), *264-265*	.50
Liner—*Manhattan* (12-in. long), *204*	.25
Liner—*St. Louis* (11-in.), *231*	.25
Privateer of 1812—*Swallow,* a Baltimore clipper (13-in. hull), *228-229-230-R*	1.00
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Show Boat, Illuminated (14-in.), *263*	.25
Stagecoach with horses, *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Steamships *Savannah* (3 in. over all) and *Atlantic* (6 in.), *235*	.25
Trading Schooner (17¼-in. hull), *252-253*	.50
"Treasure Island" *Hispaniola* (7-in.), *237*	.25
Viking Ship, (20½-in.), *61-62-R*	.75
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Rainbow* (7½-in. hull), *233*	.25
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

FURNITURE

Bench and Tilt-Top Table, Combination, *11*	.25
Bookshelf and Book Ends, Modernistic, *100*	.25
Chests, Treasure, *78*	.25
Coffee Table with Spiral Legs, *245A*	.25
End Table, Magazine, *68*	.25
Fireside Seats (wood and metal), *266A*	.25
Floor Lamp with Tripod Base, *243A*	.25
Lamps, Modern (no turning), *93*	.25
Magazine Rack, Ladder-Back Style, *250A*	.25
Pier Cabinet and Hanging Shelves, *77*	.25
Sewing Cabinets, Two, *31*	.25
Table, Four-Leaf Card, *239A*	.25
Table, Tavern, and Scroll Mirror, *105*	.25

FLYING AIRPLANE MODELS

Bremen (Junkers, 3-ft), *89-90*	.50
Nieuport XVII, 29-in., *180-181*	.50
Winnie Mae, 4-ft., *141-142-143*	.75

MISCELLANEOUS

Arbor with Garden Gate and Seats, *9*	.25
Bird House, Log Cabin, *244A*	.25
Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Garden Chair, *260A*	.25
Log Cabin, Three-Room, *134-R*	.50
Microscope Kit, Portable, *220*	.25
Projector for Photos and Pictures, *259A*	.25
Six Simple Block Puzzles, *65*	.25
Star Chart, Perpetual, *214*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

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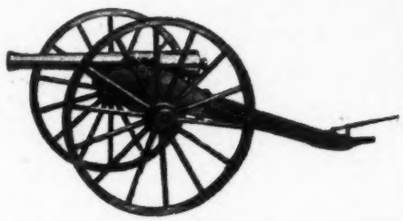
NEWS OF GUILD CLUBS

(Continued from page 79)

that members who are unable to attend regularly are kept in touch with all activities. A recent issue had nearly four columns of news about meetings and as much again on such topics as waterproofing a canvas boat or canoe, archery equipment, and questions and answers on craft problems. Among the questions answered were: "What is the correct speed for a cooling system blower with a 12-in. rotor?" and "How may jointer blades be honed without removing them?" This unusually readable bulletin is edited by W. O. Watkins, the secretary-treasurer.

Three Rivers Homeworkshop Club, Three Rivers, P. Q., Canada. At a recent one-member exhibit, S. O. Balleux displayed a wooden tray suggested by a design published in POPULAR SCIENCE MONTHLY. The exhibition of members' work at the regular meetings and the resulting discussions have proved to be an interesting and instructive feature, which other clubs might find it to their advantage to copy.



Scale model cannon by Frank W. Pratt displayed at exhibition of Cheyenne, Wyo., club

Norristown (Pa.) Craftsman Club. At a recent project contest for club members, Gustave Axelson carried off the honors among the men with an inlaid tea tray, and Henry Hayden won the junior award for wood turning. A feature of the program was a Carborundum motion picture showing the evolution of modern abrasives and correct ways to sharpen tools. . . . The by-laws of the club have been amended so that junior members under eighteen may join. Associate memberships have also been established for women. The club already has one woman member, Mrs. Houven Rutty.

Holton (Kans.) Homeworkshop Club. Two exhibitions a year will be held by this club hereafter. At the December display, an auction of contributed articles made by members will be held, and power tools purchased with the proceeds. The club will also probably join in a statewide home workshop contest to be held by the Free Fair Association of Kansas.

Onondaga Homeworkshop Guild, Syracuse, N. Y. This club and the Syracuse Herald sponsored a successful model yacht regatta on Hiawatha Lake, Onondaga Park. . . . More than 2,000 visitors attended the club's annual exhibition at the Syracuse Museum of Fine Arts. Scale models of many ships, ranging from an ancient Roman galley to the sloop *Rainbow* and modern streamlined motor craft, were on display, together with a variety of furniture, toys, and various types of craftwork. . . Because of the diversified interests of the members, each member of the board of governors has been placed in charge of a certain group of handicrafts.

Maple City Homeworkshop Club, La Porte, Ind. This newly organized club has received its charter from Guild headquarters. Dr. H. R. Evory is the president.

Mount Clemens (Mich.) Homeworkshop Club. Otto Englebrecht was awarded the Popular Science Craftwork Medal at the club exhibition for an inlaid card table. The runners-up were Leland Rood, Walter Fennell, Rhubin Ghainer, and Casey Bremer. About 50 projects were displayed.

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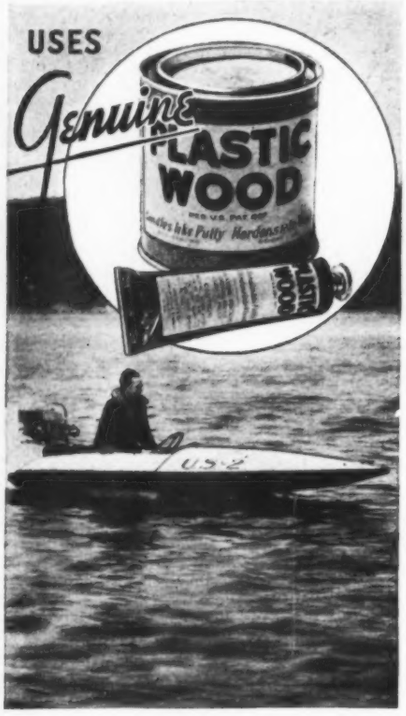

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The champion referred to, is the winner of the Albany to New York Marathon Outboard Race, Fred Jacoby and his "Flyaway."

PLASTIC WOOD

FOLDING

Canoe Chair

Has Comfortable Woven Back Rest

The completed canoe chair with slat seat and burlap-filled back. *At right:* Piece of a slat is used as a spacer when screwing down the slats

By LEONARD F. MERRILL

A CANOE chair is a comfort well worth having on any canoe trip, and a folding one is far superior to any other because of its compactness when not in use.

Materials. The chair should be made of birch, oak, or other hardwood. The following list allows for butt joints held with screws, but if you prefer mortise-and-tenon joints, make allowance for the additional lengths needed: 2 pc. ¾ by 3 by 18 in.; 2 pc. ¾ by 1 by 20 in.; 2 pc. ¾ by ¾ by 13½ in.; 2 pc. ¾ by ¾ by 15½ in.; 1 pc. 1 by 1½ by 12 in.; 1 pc. 1 by 2 by 13½ in.; 13 pc. ¼ by 1 by 14½ in.; 8 R. H. (round-head) screws 2 in. long; 2 R. H. screws 2½ in. long; 26 R. H. screws ¾ in. long; 8 flat-head screws 1½ in. long; 300 ft. of ¼-in. or 150 ft. of ½-in. flat reed, rawhide, leather, burlap, or other material for the woven filling for the back.

Framework. Cut out one of the 3-in. pieces of wood as shown and use it as a pattern in making the other piece. Round off the bottom edges slightly so as to prevent possible damage to canoe ribs.

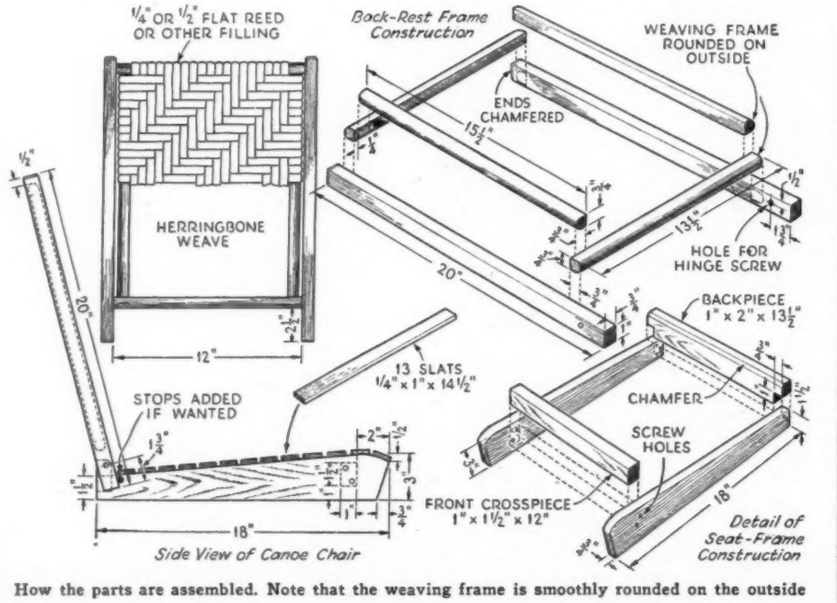
The backpiece of the seat is made from the 2-in. piece and is cut away on the ends as shown, so that the space between the sides is 12 in. The front top edge is chamfered. The 1½-in. piece near the front is simply squared to dimensions.

The frame is held with the 1½-in. flat-head screws. Holes for the screws should be drilled and countersunk in the sidepieces, but do not drill into the ends of the back or front crosspieces.

The slats, which may be either hardwood or casein-glued plywood, are spaced ¼ in. apart, project ½ in. over the sidepieces at each end, and are held with one screw in each end.

The 1-in. pieces are for the sides of the back rest, so they should have the sharp corners removed before assembling. The top ends may be chamfered or slightly rounded. A hole slightly larger in diameter than the 2½-in. screws is drilled through each piece ½ in. from the edge and 1¾ in. from the bottom end.

The weaving frame is made from the ¾-



How the parts are assembled. Note that the weaving frame is smoothly rounded on the outside

in. square pieces, each piece being rounded on one edge. This round edge is placed on the outside so that the filling material will not be cut through. The frame is put together with the longer pieces between the shorter ones and ¼ in. from their ends, the 2-in. screws being used.

The frame is set between the sides so that the sides project 2½ in. below the bottom of the frame. These joints are also held with 2-in. screws.

Assembly. Place the back rest in the position it will have when folded. Slide the rest backward or forward until the hinge holes come in the middle of the ends of the seat tie piece. Mark the location of the holes on the ends and remove the back rest to start the screws. The whole should be sanded and given a coat of shellac and again sanded lightly before starting the weaving.

Weaving. For a herringbone weave like that illustrated, tack one end of whatever filler is to be used to the inside of the frame. Bring the strand out and across the front of the frame, wrapping it around the back and across the front again. Continue in this same direction until the frame is completely covered with one layer, all running in the same direction. The cross strands form the real weaving. Tack one end as before and with the loose end weave over four, under four, and so on until you are back at the starting point again. The second time around start over three, under four, over four, and so on, each time around dropping one on the first step only.

When the weaving is completed, give the whole chair a couple of coats of spar varnish, and the job is finished.

If stops for the back rest are wanted, they may be added to the sides of the seat.

Weaving the back with burlap strips. Flat reed, rawhide, or leather also may be used

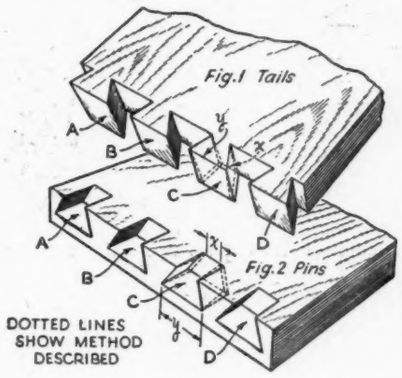
BOARD SERVES AS HECTOGRAPH

When only a dozen or two copies of typewritten or handwritten matter are to be duplicated, an ordinary softwood board can be used as a hectograph. The surface should be sanded until it is perfectly smooth, then soaked with one part glycerin in one part of water. Wipe off the surplus. Prepare the copy with a hectograph ribbon, ink, or pencil, and rub it into contact with the damp surface of the board. After a minute it can be stripped off, and sheets of plain paper placed in contact, as when using a gelatine duplicator.—W. KIRK.

SIMPLER WAY TO MAKE HAND DOVETAILS

BY A slight modification of the usual method, dovetails can be made by hand to fit perfectly, with no driving up of the work, no splinters, and no openings to fill with slivers after the work is glued up.

The usual way of cutting dovetails is square with the end surface on the pins (Fig. 2 at *A* and *B*) and with the face surface on the tails (Fig. 1 at *A* and *B*). When made in this way, the work is hard to join up without splintering the face of the tails as the parts are driven together. If the tails are made small enough to enter the other part without driving up, then there are small openings around the tails



The dovetails are sawed on a slight bevel so that the parts will fit together easily

that have to be filled with slivers, which always show.

The method I have used in dovetail work for more than thirty years eliminates this difficulty. The difference is in sawing rather than in laying out, as indicated at *C* and *D* in Figs. 1 and 2. Lay out the dovetails square in the usual way, but in sawing them, bevel from the face exactly the thickness of saw blade, as indicated by the dotted lines. This makes a tapered joint, the walls of which do not meet until the parts are all the way up, allowing the joint to slip together easily. If not a perfect fit, it is easily slipped apart for further fitting. When finally clamped up, the joint is forced together in a perfect fit. Make this lateral bevel so that *X, X* are the same, also *Y, Y*.

I always use a dovetail saw because a back saw or other saw with a regular saw handle is not satisfactory with this work. A dovetail saw has a round handle such as a scroll saw has. Therefore, it can be easily held in any position necessary for close and accurate cutting.—R. C. STANLEY.

HOW TO BAKE ON ENAMEL

ALTHOUGH baking enamels give a most durable finish to metal parts and are not so likely to become marred as are ordinary lacquers, they are seldom used in the workshop because of the absence of a baking oven. A substitute for an oven can be quickly made, however, and it will give satisfactory results for small jobs where quick production is not necessary. Only a wooden packing case of suitable size and an electric reflecting type heater (such as are frequently used in the bathroom) will be found necessary. The most satisfactory method is to cut a hole in one end of the case so that the heater can be placed against it and thus project the heat inside. The lid should fit tightly, but no additional insulation is necessary as wood is a fairly good heat insulator, especially if thoroughly dry. Ordinary precautions should be taken, of course, against fire.—K. L. ROBBINS.

IS YOUR CAR ALWAYS READY TO GO ?

A friend of ours, without meaning to be, is an "original model" for practical economics.

He is an independent taxi owner in New York—about as tough a place to make a living in that business as there is. Owns an old cab, with over 110,000 miles on it. But there is one thing about him—he is always on the job, rain or shine, snow or sleet, and in the *same* cab.

We asked him the other day how he did it, and this is what he said (with certain modifications of expression):

"This is a tough job in which to make a living. The only way I have of getting cash is with this cab. In spite of slim pickings, I'll bet I pay more for oil than most cabbies; but it's worth it, because I found out long ago that repair bills can eat up the profits.

"I've used Quaker State Motor Oil for years. Hear that motor? Well she won't turn over more than 45 on level ground any more—but, boy, I won't trade her in until the body falls apart. She's one sweet engine.

"You don't hear any squeaks in the chassis either, do you? Not lately, anyhow, because I use the Quaker State Lubricants.

"Believe me, I've got to keep on the job and out of the repair shop—and I know Quaker State helps me do it."

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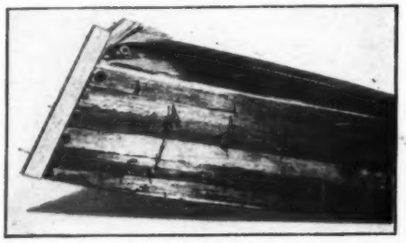
PLANKING OUR MOTOR-BOAT MODEL

(Continued from page 66)



Scribing side plank (Fig. 2); attaching outside stem and keel (Fig. 3); and, above, the temporary pins and screws

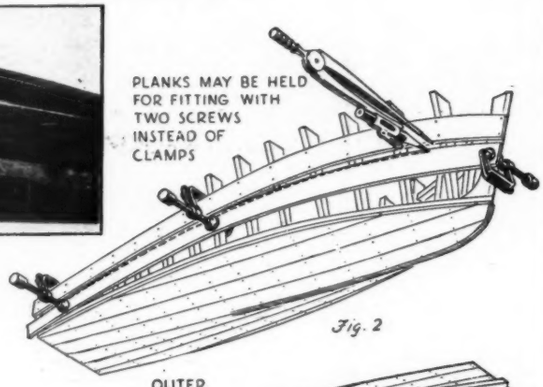


Fig. 2

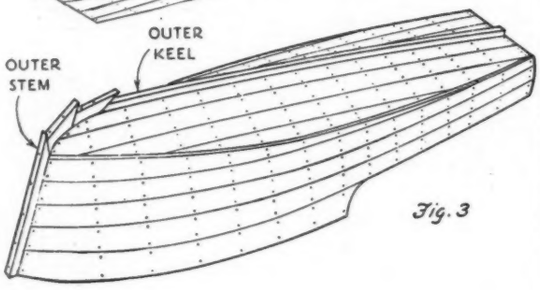
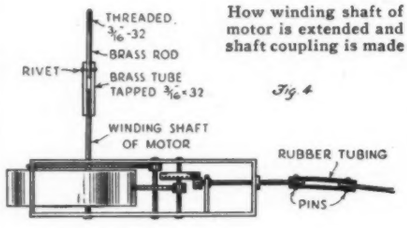


Fig. 3

through keel large enough for tubing. Do not bother to bore a slanting hole; simply slot keel as in Fig. 5. It will be necessary to cut lower ribs out in center so that shaft may pass over them. Bore a vertical hole through keel large enough for brass rod used as a strut, about 2½ in. from the stern. On strut put a nut and washer; insert shaft and propeller in tube; insert tube through slot in keel, and push strut up through hole in keel. Use nut and washer on inside, and adjust outside nut and washer until propeller clears bottom of keel by about ¼ in. You may have to trim out slot in keel and notches in ribs to get shaft to line up with motor. Be very careful not to spring shaft tube. When in line, hold by blocking up the inside and gluing. Fill keel slot with a wood putty made of wood flour and cement or with a commercial wood mastic. Make a mound on inside from bottom of boat up over tubing as shown in Fig. 5. Turn boat over and fill up slot in keel flush with edges, using same compound. This makes a neat job on outside without boring a hole at exactly the correct angle, and it is as strong and more water-tight.

Rudder. This is made as shown in Fig. 6, about 1½ by 1¾ in., and inserted through hole in keel. You may purchase a rudder ready-made if the necessary taps and dies are not available.



How winding shaft of motor is extended and shaft coupling is made

Fig. 4

Deck and Cabin. Cut deck beams on a 12-in. radius from ¼-in. material. They are ⅜-in. deep. Place one at each rib. The cockpit must have a set of floor beams. These are ¼-in. square pieces laid across boat from rib to rib and glued. They are held with pins while drying. The side sheathing is then glued to side ribs and held with pins or screws with washers under them. The floor is now laid.

Put in portholes as shown in side view. These are pieces of soft brass bent around a dowel and inserted in a ½-in. diameter hole in a maple block, with a short length of dowel inside, so the edges can be hammered over. Make these edges narrow and trim up the joint, forming a round flange. Bore ½-in. holes in boat very carefully. To avoid splitting, mark centers of each porthole and drill a hole at this point the size of the spur on the wood bit to be used. The bit then will not pull; but when turned in the hole with very light pressure, the lips will cut through the hull cleanly, if used first on inside, then on outside.

The bulkhead at after end of cabin is fitted, and the raised deck laid. It is wise to leave a hatch in it, with screwed-down cover, large enough for removal of motor in case of spring breakage. A hatch in cockpit floor is also desirable. Finally trim off top edge of cockpit sheathing and lay *(Continued on page 85)*

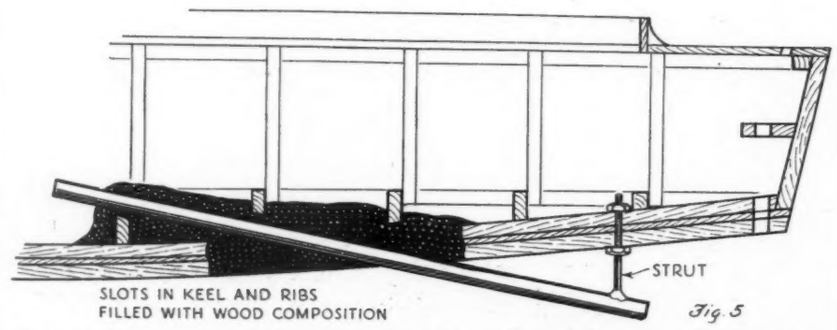


Fig. 5

Sectional view of after part of hull with shaft and strut. The dark area is wood composition

NEW MOTOR-BOAT MODEL

(Continued from page 84)

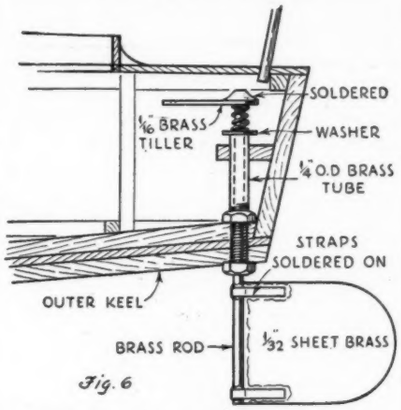


Fig. 6

Method of making and installing the rudder. If preferred, a ready-made rudder may be used

side and after decks. A seat is built in at stern as shown by the plan view in the previous issue. The rudder may be connected to a steering wheel on bulkhead with lines run from tiller through screw eyes along each side of cockpit, through two more screw eyes behind bulkhead, and up to wheel at bulkhead.

The canopy or roof is made as in the side view. The cockpit coaming is glued on. Fill all cracks with a good grade of filler that hardens well. Sandpaper smooth and paint. When painted, you may put on chafing strips previously prepared from strips of planking 3/16 in. wide, sandpapered half-round, stained, and varnished. These are nailed on with No. 20 brass escutcheon pins ½ in. long. Do not drive any pins through these rub strips without first drilling holes.

Brass trimmings may be purchased from any model boat supply house, or you may cast them in sand with type metal, using whittled wooden patterns. Type metal will melt over a gas flame.

As a final suggestion, if you wish more speed, use a propeller 1½ in. in diameter of the deepest pitch you can get instead of the 2-in. propeller that usually comes with the spring motor. Of course, the boat will not run for as long a time on a single winding with the smaller propeller.

A SCRAPER FOR VARNISH RUNS AND OTHER DELICATE WORK

For scraping delicate work and for reducing varnish seams or runs, an old single-edged safety razor blade makes a good tool if it is first held perpendicular to the face of an oilstone and drawn lengthwise back and forth sufficiently to assure a smooth edge. The corners also should be slightly rounded. Such a scraper can be ground, if necessary, to conform to the surface to be scraped. When scraping a varnish seam or run, wet the surface with water. Bear in mind that the underlying varnish is apt to be somewhat soft and therefore should be allowed to dry before the whole surface is rubbed to a smooth finish with pumice stone and water in the usual way. —Clifford W. Morton.

CLEARING PLASTER FROM HOLES

Electricians are often annoyed to find, when finishing up wiring jobs, that the screw holes in the ears of switch boxes have been filled with plaster. This is likely to cause the 6-32 mounting screws to shear off before they are screwed up. I carry a small tap wrench with a standard 6-32 taper tap to clear out the plaster, and never try to force a screw directly into a plaster-filled hole.—Louis N. Goodman.

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WASHING PHOTOGRAPHS THOROUGHLY

(Continued from page 70)

Cut films and plates are easiest to wash. A simple, homemade wooden box will do the job very nicely when placed under the tap in sink or bathtub. A wooden wash box for cut film is shown in one of the illustrations. Water runs in from the tap at one end, through holes in the bottom of a slotted partition, around the films, and out into the sink by way of a series of holes. The slotted partitions are placed slightly closer together than the length of the cut films so that the latter will be bowed when slid into the slots. A plate wash box should be made the same way except that the partitions should be spaced so that the plates will drop into the slots.

IT IS not necessary to make a wash box of this type absolutely waterproof, but put it together solidly with screws and treat the wood with paraffin or waterproof paint.

Roll film has a tendency to curl or roll up and thus keep the water from reaching all surfaces. A simple way to overcome this trouble is to fill the bathtub with cold water and stretch the film lengthwise just under the surface with the aid of a pair of clips and two pieces of string. Leave the film in the water for a half hour. To save water, you can stretch the film close to the bottom of the tub, run enough water to cover it, allow to stand for five minutes, run off the water and run in fresh, wait five minutes more, and so on for five changes of water.

Film-pack film also can be conveniently washed in the bathtub or in a laundry tub by suspending the individual films on clips hooked to wires or strings strung across the top of the tub on a light wooden frame. This method, obviously, is fine for cut film if you do not wish to go to the trouble of building a special wash box.

Both film-pack film and cut film also can be washed by the use of two trays. Fill one tray with fresh water and immerse the films, one by one. Leave five minutes and then transfer the films, again one by one, to the second tray full of water. At the end of another five minutes, dump out the water in the first tray and, after refilling with fresh water, transfer the films in the same manner back to this tray. Because the films, while in the trays, are piled on top of each other and consequently do not get the full benefit of the changing, go through this procedure at least six or seven times.

This method of washing is very economical of water, but is open to the objection that you are likely to damage the films unless you handle them very carefully.

ONE excellent way to wash either prints or enlargements is to use a commercial tray siphon of the type shown at the bottom of page 70. This is hooked over the edge of the tray, which should be supported next to the sink on the drain board. Connection is made to the tap by means of a rubber tube and a supplied fitting. The device squirts a stream of water that keeps the prints stirred up and automatically siphons off the water above a certain level so there is no danger of overflowing.

There are also available round print-washing tanks made of galvanized iron. They have two disadvantages. One is that they are so constructed that it takes an unnecessarily large flow of water to keep the prints moving; the other is that in time the galvanized iron starts to rust and thereafter you will have trouble with dirty rust spots on your prints unless you wipe them very carefully before drying.

A homemade wash tank that overcomes these two disadvantages is illustrated at the top of page 70. It is soldered together of sheet monel metal, the cost of sufficient of this metal being $1.75 as compared with the cost of about $5 for a similar size commercially built galvanized-iron tank. Monel metal will never become rusty. A piece of copper pipe was squeezed nearly flat at one end, and the other end was fitted, with the aid of friction tape and a hose clamp, to short length of garden hose. The end of the pipe was bent so that the end is immersed when the pipe is hooked over the edge of the tank. This pipe squirts a stream of relatively small volume but of quite high velocity, and it keeps from twelve to fifteen 8 by 10-in. prints constantly moving so that they never settle to the bottom at all.

The shape of this tank, square with rounded corners, is better than a truly round tank, as in the latter the prints form in a compact mass in the center and spin around. Furthermore, this tank enables an occasional 11 by 14-in. enlargement to be washed.

IF YOU want to be really scientific in washing films and printing paper, there are two test methods that are worth while.

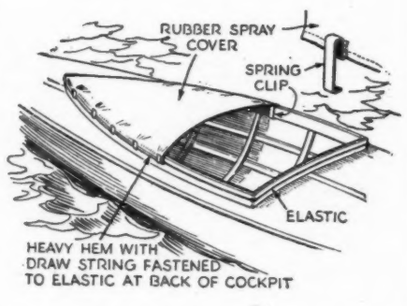
With any kind of wash tank or wash box, you can test the rapidity with which the water changes by pouring into it, after it is filled and overflowing in the usual manner, a small amount of red ink or an ounce or two of a solution made of any of the so-called Easter egg dyes. Of course, this test should be made when no films or paper are in the tank. Note the time when you pour in the dye and then see how long it takes for the color to disappear completely. Add this time to the ideal washing times already mentioned.

These figures apply only to film or paper wash tanks where the water constantly circulates about all paper or films surfaces.

The other scientific test for adequate washing is a chemical one to determine if any hypo remains in the print. The test solution consists of 4 grains of potassium permanganate and 8 grains of sodium hydroxide dissolved in 8 ounces of distilled water. To make a test, stir ¼ dram of this solution in 8 ounces of water and let the drippings from a print lifted from the wash tank fall into the solution. In about thirty seconds the violet color will change to orange if even a trace of hypo is present.

As impurities in the water supply also will cause the test solution to change color, it is well to make a test with a few drops of tap water and note what change in color, if any, it produces. Any variation in this color change will indicate the presence of hypo.

SPRAY COVER ON KAYAK HELD WITH CLIPS



WITH a sailing kayak, a spray cover is a convenience even if it is used only at the forward part of the cockpit to catch the spray from the leeboard. I made mine from brown rubber sheeting with brass clips at about 6-in. intervals as shown. In case of an upset, the spray cover may be pulled away from the clips. Ordinarily, however, the cover is removed by releasing the spring, and the clips are left on the cover.—C. H. T.

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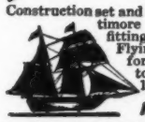

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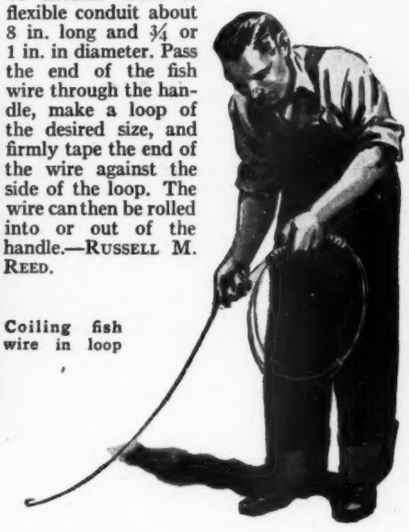
HANDLE FOR COILING STEEL FISH WIRE

DIFFICULTY is often experienced in holding a coil of electrician's steel fish wire while rolling it up or unrolling it to snake wire through conduits. This may be overcome by making a handle out of a piece of circular loom or flexible conduit about 8 in. long and ¾ or 1 in. in diameter. Pass the end of the fish wire through the handle, make a loop of the desired size, and firmly tape the end of the wire against the side of the loop. The wire can then be rolled into or out of the handle.—RUSSELL M. REED.



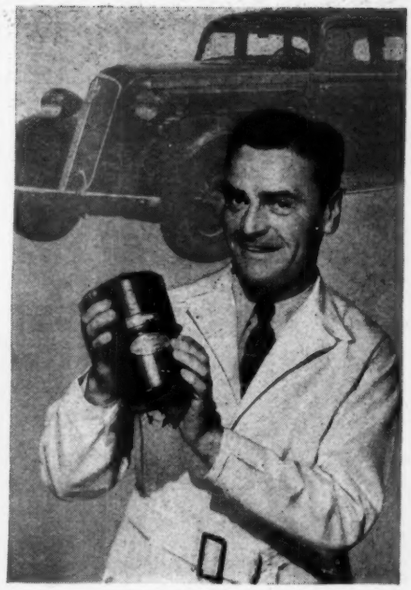
Coiling fish wire in loop

GATE ARCH MADE FROM OLD AUTO FRAME

A STURDY gate arch for use in a wire fence may be assembled from a junked automobile frame. An arch is superior to the steel posts and braces ordinarily sold for the purpose.

The frame side members should be cleared of brackets with a chisel and hammer, and sawed off about 9 ft. from the front. The main leaf from a front spring or an iron rod with the ends bent at right angles will serve as the upper spreader. The arch will look neater if the rivet holes are sealed. This may be done by placing soft aluminum or solder in the hole and expanding it by holding a hammer on one side and pounding on the other. Paint the frame and set it in 2 ft. of concrete.—DONALD R. FOSLER.

How the arch looks in use on the front lawn



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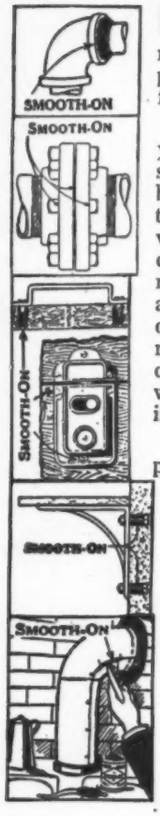

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SMALL WATER-POWER ELECTRIC PLANTS

(Continued from page 69)

line is grounded. This is accomplished by carrying a wire from the lower right-hand side of the switch out to a plate buried in the stream bed in the tailrace. Fuses contained within the switch cabinet protect the lines. Two No. 1 wires run several hundred feet along the pole line to the points of distribution. Large wires are used to keep the voltage drop low. This plant is sufficient to furnish light to the house and outbuildings, heat in the brooder houses, and power service of a light character.

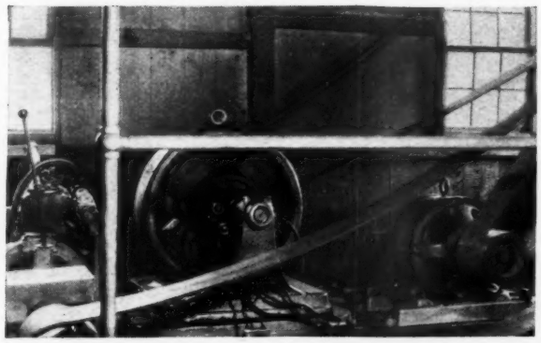

Fig. 8. Large A.-C. generator, small D.-C. generator, which is an old rewound motor, and, at left, the auxiliary gasoline engine

A plant that was built twenty years ago and has rendered excellent service ever since is shown in Fig. 6. It is a river plant and uses a concrete flume. The dam is a natural dirt and grass-sod embankment. There is an overflow spillway out of the view to the left. The arrangement provides a 7-ft. head and a 4-ft. fall, and makes use of a vertical turbine with a runner nearly 3 ft. in diameter. Vertical types require a twisted belt, and an idea can be obtained in Fig. 9 of how the change is made from vertical to horizontal drive. The large driving pulley is 48 in. in diameter, and the driven one on the countershaft is 24 in.

Fig. 9. Crossed drive belt with idler pulley

As this plant supplies power to industrial motors as well as for lighting, its generators consist of a 25-kilovolt-ampere, three-phase A.C. alternator running at 1,800 r.p.m. and of 440 volt, 60 cycles; and a 110-volt D.C. generator of about 8 kw., which is a converted 10-h.p. compound-wound motor, its speed being rated at 1,150 r.p.m. The former supplies the motors of the factory nearby, while the latter gives the lighting service. Figure 8 shows the generators and also the emergency gasoline engine with its slack belt all ready to be thrown on in case trouble develops in the water drive. The A.C. generator of 440 volts, three phase, is of the self-exciting type—that is, it generates the D.C. current required to energize the fields by means of an extra winding and commutator with its own brushes. This is in contrast with a generator that requires a separately driven exciter.

It is most important in any generating plant that the voltage be kept constant under varying load conditions. There is a natural tendency when load is supplied for the voltage to drop. The amount of drop depends on the character of the load. In the plant just described, a compensating governor-controlled regulator is belted to the countershaft. When the speed of the turbine starts to fall because of an added load, the regulator automatically opens the turbine gates a little, thus speeding up the generator for increased voltage. When the load is again reduced, the gates are proportionately closed again. This device is shown in Fig. 7, and in Fig. 10 can be seen how it is coupled to the gate mechanism by means of gearing.

In D.C. generating plants, the use of compound-wound generators is a help in voltage control. This type of machine uses both a series and a shunt field winding, and as the load in the circuit is increased, the added current flowing through the series winding causes an increased magnetic flux, which will in turn cause a rise in the voltage. It is usual to wind a compound generator as an "overcompounded" type, which has its series winding so proportioned that its full load voltage is much greater than its no-load voltage, a fact that is a help to distant points on the line and also compensates for line drop.

However, when large loads are suddenly thrown on the line, it is difficult for any generator to cope with the situation unaided. For this condition many plants install an automatic voltage regulator. This consists of a contact-making voltmeter of special design and a relay with the necessary wiring connections and other small parts. The device will maintain the voltage within one or two volts under most conditions, provided, of course, that the generator and its driving power are of sufficient capacity to carry the load in question. If the voltage drops a point or two, a contact is made and, through the relay, resistance is cut out of the field circuit, thus increasing the voltage. The reverse is true on a rise in the voltage. This gives accurate regulation.

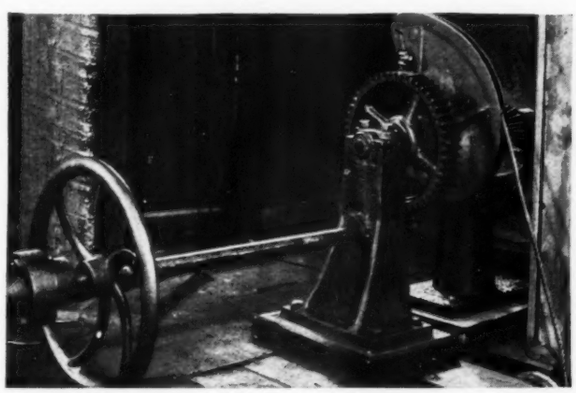

Fig. 10. The controller is operated by a gear reduction and quadrant. The box at right contains the vertical turbine shaft

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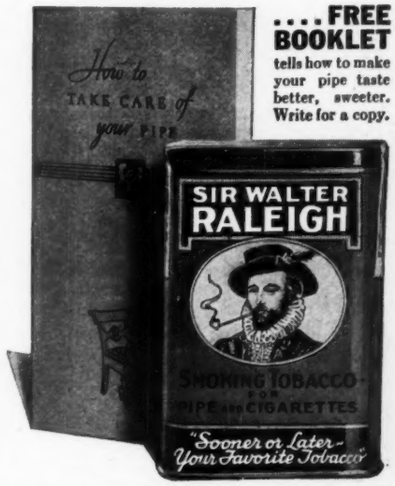

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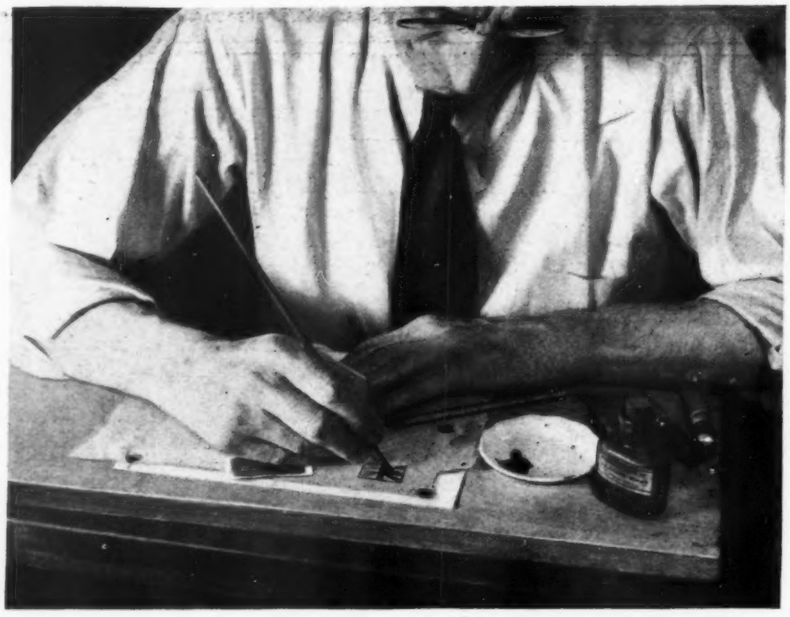

METHODS OF COLORING SHIP MODELS

(Continued from page 61)

should not, in my opinion, be antiqued at all. They must have a neat, sleek, but not yacht-like appearance.

As all the other modern sailing vessels will be more or less modifications of the clipper ship, I shall describe how I ordinarily paint one. The painting of the hull should be completed before any rigging is set up. If the hull is to have real copper sheathing, this should be put on first; if not, then the whole, after careful sandpapering, should have a thin coat of shellac, followed, if it is a large model, by a thin coat of paste wood filler, carefully wiped off. Next a coat of flat white is applied. This will show up any inequalities or scratches, which should be entirely eliminated at this point to save future trouble. I find that thick paste wood filler makes the best putty for small work.

Two or three coats of flat white should then be applied. Allow each to dry thoroughly and rub it down with No. 00 sandpaper between coats. Mark in the water line; and along it, above, lay a strip of decorator's masking tape, or gummed paper with a perfectly smooth edge. See that it adheres closely all along. Paint up to this to imitate copper color, which I do with burnt sienna and Indian red. Work some emerald green in the bends and here and there where the verdigris would cling. I prefer artist's oil color for this blending work. One coat should be sufficient. Metallic paint can be used, but with it I have not been able to get an effect that satisfied me.

When this is thoroughly dry, remove the tape, wipe off any stickiness, and place another strip of tape on the bottom paint to meet its edge exactly. Coach paints ground in japan are the most satisfactory for the upper part of the hull. Dilute the color quite thin with turpentine and brush on one coat after another until you have a body of color built up; then very carefully sandpaper and rub down with powdered pumice stone. Next apply more coats, using less turpentine but adding varnish in increasing proportions until the final coat is an enamel. The gloss of this will probably be too high, so rub it down with pumice stone; or what is easier and, I think, rather better looking, is to sandpaper it lightly and apply a thin coat of dull-drying or "rub-effect" varnish. This can be used on the lower part of the hull also. As an alternative, this type of varnish can be used to mix with the paint.

This will give an even, all-over coat, but a more artistic effect is obtained on a black hull by painting the last coat with a stiff brush and working in a little blue and red direct from the palette without mixing them. The colors should not be obvious, but they will give the black some life.

A white or colored stripe, if on a molding, can be first painted its color and then omitted when painting the body color. Either a molding or a flat stripe, however, may be more easily painted after the body color is dry by using two strips of masking tape. If unable to manage this neatly, where there is no molding, glue on a strip of thin paper and paint that. For white lettering on black, I leave a patch of white and then outline the letters with a pen in India ink; this, when varnished, looks just about the same as white paint on black.

For inside the bulwarks and for deck houses and the like, I use white (or colored, if called for) coach paint, giving them two or three thin turpentine coats and one with dull drying varnish. These parts and the masts and yards should be painted as one progresses, preferably before being fastened on the model.

I have seen colored lacquers used on small models with success, but prefer oil paints. There are, however, some occasions on which I use lacquer. Glue will not adhere firmly to oil paint, but the cellulose household cements will stick to lacquer because they soften it and reach the wood beneath. It is therefore more convenient to lacquer any part to which other parts will have to be cemented. At an early stage of the model, to keep the decks clean, I give them a coat of clear lacquer, used for this reason. Do not apply lacquer over paint.

In making a good model, many little brass parts are required. These look neat if polished and lacquered, but that is rarely correct. One hears of a sailing ship arriving with her brasswork gleaming, but the extent of this would be the rim of the wheel, binnacle top, gratings on the skylights, a few poop belaying pins and deadlight rims, if any. It would not include jackstays, yard trusses, capstans and the like, which were iron. *(Continued on page 91)*

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COLORING SHIP MODELS

(Continued from page 90)

The deck ironwork was usually black, but sometimes green with red pump wheels. The ironwork aloft was usually the same color as the masts or yards, but was sometimes black on white wood. Mast bands were frequently painted in this way. Iron on natural color spars might be black or white.

Blocks in early ships appear usually to have been left unpainted, but in later vessels they were painted to harmonize with the spars.

Deadeyes got a liberal dose of tar along with the lanyards, so should be black. Anchors and old-time guns were always black.

Chain should always be black, never gold or silver. The best way to blacken copper is to dip or paint it with a solution of liver of sulphur. To oxidize brass, make a solution of hyposulphite of soda, 1 oz.; lead acetate, ½ oz.; and water, 1 pt., at 180 deg. F. If paint is preferred, there is a mat lacquer used for painting the metal work on cameras that is excellent. I use this also for touching up the rigging where necessary. It and other lacquer colors can be thinned with a special thinner or acetone.

With regard to gilded parts, a book of real gold leaf does not cost much and lasts a model maker a lifetime. On small surfaces it is easy to apply and will look permanently like gold. Japan gold size is used to make it adhere; but for all one needs in this work, some thin shellac, varnish, or even glue will do. Leave the adhesive until it gives just a suspicion of tackiness to the back of the finger. I cut small pieces of the leaf with a razor blade and apply them with a dry camel's-hair brush which has been drawn a few times over the coat sleeve or hair.

I prefer flags painted on thin silk. This can be done by drawing the pattern on paper and pinning the silk over it so that the lines will show through. Artist's water colors can be used by mixing gum or fish glue with the water to prevent them from running. Oil colors, however, are preferable because the colors are stronger. They can be used by extracting most of the oil on blotting paper and then mixing them with any of the liquids sold for painting fabrics. Another way to prevent the color from running is to rub into the silk a pounce such as is used on tracing cloth by draftsmen to prepare it for inking. The edges can be hemmed on large flags, or wiped with clear varnish to stop them from fraying.

Do not gum up your model with heavy paint and destroy the beauty of your neat workmanship, yet do not let it have a starved appearance. A little cleaning with a file in corners is sometimes helpful. Work for color harmonies, contrasts, and a vibrating, lifelike effect as if you were painting a picture, which, indeed you are.

These hints are not intended for finishing prototype or sailing yacht models, which require immaculate, highly glossy surfaces.

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BEAUTIFUL trinket or jewelry boxes can be made from small pieces of molding of almost any shape or kind of wood. The tools needed are a true miter box, a saw, and a sharp block plane, together with a little glue and sandpaper. Cut the moldings the desired lengths, fit them together around the corner of a square block and sandpaper and shellac the pieces on the inside before gluing them together. Don't try to glue all four sides at once; do two and two, let the glue set, and then join the two half sections together.

If it is a small box, the cover can usually be made of the same kind of molding as the sides, only miter it lying flat in the miter box instead of standing up. Glue and nail on a ¼-in. bottom and sandpaper and finish with lacquer or stain and shellac.—W. HARVEST.

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HUNTING STRANGE CREATURES WITH YOUR MICROSCOPE

(Continued from page 47)

produce a thick liquid in which the animals find it difficult to navigate with their customary speed. You can obtain gelatin at any drug store, in sheet or granular form; the unflavored kitchen variety, intended for making desserts, also is suitable.

Perhaps the easiest way of confining the activities of the specimens to small areas and slowing them down to a speed that permits detailed study, is to place a bit of ordinary absorbent cotton beneath the cover glass before adding the drop of water. Spread the cotton fibers out into a thin layer, so that they form a network. The creatures will be trapped within the meshes of this network, and thus kept within bounds.

Although a great deal of their structure can be observed by studying protozoans and other minute organisms in their natural condition, the application of stains will bring out otherwise invisible characteristics. But the majority of microscopic stains quickly kill these delicate creatures, often causing them to fold up into meaningless balls. There is, however, an easy way of applying stain to living protozoans and the like.

THE stain commonly used is neutral red, obtainable from biological supply houses and some of the larger drug stores. Make a weak solution by dissolving one tenth of a gram in 1,000 cubic centimeters of water. This is approximately equivalent to three grains (avoirdupois) dissolved in a quart of water. There are two ways of using the stain. One is to place a drop of it at the edge of the cover glass, and then persuade it to flow beneath the glass by applying a blotter at the opposite side. You can watch the staining action penetrate the infusorians and color the granules inside their bodies. Another way is to mix a drop of the stain with four or five drops of water containing the specimens, letting it act for a time, and then transfer a drop of the preparation to a slide.

The making of permanent slides of protozoans and minute many-celled animals is a process that might be classed as a sport, for the elements of uncertainty and surprise are prominent. Because of their smallness and delicate structures, and often their ability to fold up into something that resembles nothing in particular when anything happens to interfere with their normal activities, these tiny animals are not at all easy to mount.

However, a good protozoan slide is worth all the trouble involved in making it. The process involves, briefly, cementing the animals to the slide, killing and fixing them, staining, removing water, and applying the mounting medium and cover glass.

MAYER'S albumen fixative is used for fastening them to the slide so they will not be lost during subsequent handling. To make this fixative, beat the white of an egg until it is foamy, then pour it into a tall tumbler or similar container. Let it stand until a froth or scum has collected at the top. Transfer the clear liquid under the scum, to another container, and add to it an equal volume of glycerin. To prevent spoiling, add two grams of salicylate of soda to each 100 cubic centimeters of the mixture. Filter through cotton into a properly labeled bottle.

Clean several slides to remove grease, and place a tiny drop of the albumen fixative in the center of each. Spread this out with your finger into a very thin, even film. Set the slides aside in a dust-free place, if they are not to be used immediately.

Place in the center of each slide a drop of the water containing the organisms. Try to include as little sand and undesirable debris as possible. Inspect each slide with the microscope at this point, to make sure that it contains the desired specimens. Do not use a cover glass. Place the slides on a flat surface and let them dry until only a slightly moist spot remains where the water drop was. Now transfer them to the fixing solution, which kills the tiny animals and at the same time "fixes" their bodies so that they are not shrunken or distorted.

There are several preparations commonly used for fixing tissue, which may be employed on protozoans. One, Worcester's fluid, is prepared according to the following formula: Formaldehyde (40 percent formalin solution), one ounce; water, three ounces; and as much bichloride of mercury (corrosive sublimate), as will be dissolved.

BICHLORIDE of mercury is a powerful poison, so be extremely careful in handling it. It is obtainable in tablet form, two or three average-size tablets being sufficient for the amount of formaldehyde solution given above. The formaldehyde usually sold at drug stores is of 40 percent strength. Keep the solution in a bottle plainly marked "poison."

Another fixer you might try is a picric-alcohol solution made as follows: Water, forty cubic centimeters; ethyl alcohol ninety-five percent, forty cubic centimeters; and picric acid 0.16 gram.

Picric acid stains the skin yellow, so avoid handling it any more than is necessary.

Fix each slide for a half hour in Worcester's fluid, and then wash in several changes of water, over a similar period.

Various staining materials can be used. Eosin, haematoxylin, iodine, acid fuchsine, mercurochrome, and many other stains will give good results. Try using two stains together, such as eosin and haematoxylin. The stain can be applied by immersing the slide in a solution of it, or by laying the slide on a level surface and spreading a little pool of the stain over the area containing the specimens. A half minute or more will be required for complete staining. If the color is too deep, it usually can be reduced with alcohol.

AFTER staining, the final mounting can be accomplished by flowing a half-and-half solution of glycerin and water over the specimen area, letting this stand for a half hour, and then replacing it with pure glycerin, finally adding the cover glass. Remove excess glycerin with a piece of blotter or filter paper, until the glass is dry, and then seal the cover glass in place with gold size. Such a slide will last for a long time, but is not as rugged or permanent as a balsam mount.

Before balsam can be used, the specimens must be dehydrated. This is accomplished by leaving the slides for successive half-hour periods in baths containing fifty-, seventy-, eighty-five-, and ninety-five-percent alcohol. It is necessary to remove the mercury that entered the specimens during fixing with the Worcester fluid. To do this, add iodine to the seventy-percent alcohol bath until it is colored fairly deeply. Usually, ninety-five-percent alcohol is strong enough for the final bath, although absolute alcohol is better, particularly in a damp climate.

When all water has been removed, flood each slide with xylol for a minute or two, drain, place a drop of balsam in the center, and lower the cover glass into place.

You will find it instructive to experiment a little with this process. For instance, you may be able to produce excellent slides by putting them directly into ninety-five-percent alcohol in which some iodine has been dissolved, after straining and rinsing. Change to a second ninety-five-percent *(Continued on page 93)*

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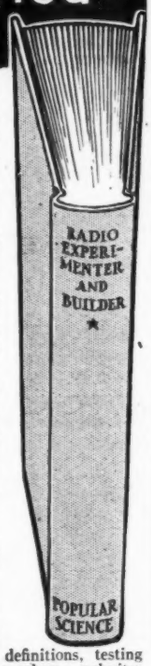

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HUNTING TINY ANIMALS WITH YOUR MICROSCOPE

(Continued from page 92)

alcohol bath, (without iodine) for fifteen seconds or so, and then to the xylol. Leaving the specimens too long in alcohol will remove some stains, such as eosin. In transferring slides from water directly to ninety-five-per-cent alcohol, or from the strong alcohol to water, diffusion currents which might prove troublesome are avoided if the slide is plunged quickly beneath the second fluid.

For handling slides in minimum quantities of solutions, special slide-staining dishes or jars, with grooved sides, are available. Just as satisfactory are small graduates or jars whose inside diameter is slightly more than one inch. Two slides, back to back, can be inserted into them without fear of damaging the specimens.

THIS process of mounting protozoans will, you will find, at the same time serve to trap diatoms and other interesting plant forms as well as microscopic animals. Although it may be desirable to have the specimens segregated, there is no particular objection to having diatoms and amoebas, or other animals, on the same slide. They live together in nature.

Your adventures in a drop of stagnant water may lead you to wonder about the water that you drink. If your relish for the water will not be disturbed by making surprising discoveries about it, you can have fun in making a microscopic examination.

If you merely take a drop of water from the faucet and put it on a slide, the chances are several million to one that you will find nothing. It probably is a fact that every city water supply in the world contains microörganisms, and frequently other interesting things such as insect legs. To capture these objects, it is necessary to strain the water through very fine silk. Water is allowed to run through the silk for several minutes, after which the layer of sediment is washed from it to a microscope slide. You can make a holder for the silk from a ten-cent strainer.

The finding of rotifers, snake-like nematodes, pieces of insects, diatoms, algae, and similar things in your drinking water does not indicate that you should stop drinking it. Such creatures usually are dead when found, and the insignificant amount of meat or vegetable matter you consume by drinking the water means nothing at all. Anyway, your body is equipped with defensive forces to handle such organisms as may enter it in food and water, and by other routes.

NEW THEORY FORESEES EARTH AS FUTURE STAR

NEW theories indicate that the earth's core, is constantly getting hotter, according to Dr. Bailey Willis, noted geologist of Stanford University. In future ages, he foresees, this heat may melt the outer shell and the earth may take its place with other glowing bodies in the heavens.

METEORITES' AGE LINKS THEM TO SOLAR SYSTEM

DID meteorites originate within our own solar system, or are they wanderers from outer space? New light is thrown on this controversial question by S. K. Roy, assistant curator of geology of the Field Museum of Natural History, who calculated the age of twenty-three meteorites—that is, the time elapsed since they solidified—from a study of the radioactive substances they contained. None of them yielded values exceeding 3,000 million years, which is a commonly accepted figure for the approximate age of the earth itself. The new evidence thus confirms the possibility that meteorites are disintegrated parts of our own solar system.

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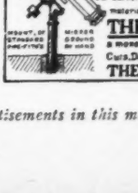

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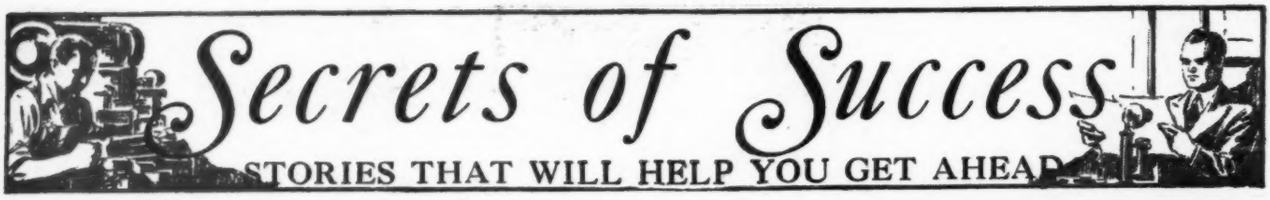

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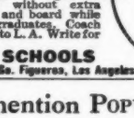

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Secrets of Success

than that. When a man chooses for his life's work one of the fastest moving, most rapidly growing industries of our age, you can't cover the ground in a few words.

While still in high school, Southern was making his plans. Even in those days he was aiming at a career in radio. So far ahead had he planned, that he borrowed money and took a course of home study radio training and completed it along with his high school work. This was in June 1926.

A few months thereafter, in November 1926 to be exact, he took the Government examination for radio operator, passed it and obtained a first class operator's license. (Only two of those who took the examination came through successfully.) He went to work immediately as relief Radio operator at a radio station in Nebraska.

Desiring to round out his radio operating knowledge, his next step was to obtain a berth on a sea-going ship which brought him to the Atlantic seaboard, and gave him a chance to see more of this great country of ours. Needless to say, the experience and travel was in itself a wonderful adjunct to his education.

Even as far back as his early operating days, Southern realized the advantages of preparedness. His work as a "brass pounder" threw him in contact with other operators, who, while older than he in years and experience, lacked his systematic plan for getting ahead in the radio profession.

The next time friends heard from Harry Southern, his letter was postmarked "Texas," and he was the radio operator of a steamship of a large oil company. The reason for the change was soon apparent —promotion—and a 25% increase in pay; gradual advancement, a part of a well-laid success system.

Now the major part of Southern's idea involved obtaining a college education. The plan up to this time had been engineered very well, and by the fall of 1928 he had made connections as a radio operator at a broadcast station in Kansas, which was so located as to give him in addition to valuable experience, the opportunity and the necessary time to attend the University of Kansas.

In September 1930, another chance presented itself to Southern—a chance which fitted admirably in his carefully laid program. He received an offer from a radio station which was owned by one of our fine western universities. He accepted this offer, which placed him in charge of the installation, and later gave him the position of chief operator of that station. He was thus enabled practically to be a full time student at college with radio paying his way.

He held this position until he had finished his college work. Following his graduation from college, he came east and obtained a fine position in the laboratory of one of the largest radio organizations of its kind in the world, which position he holds today.

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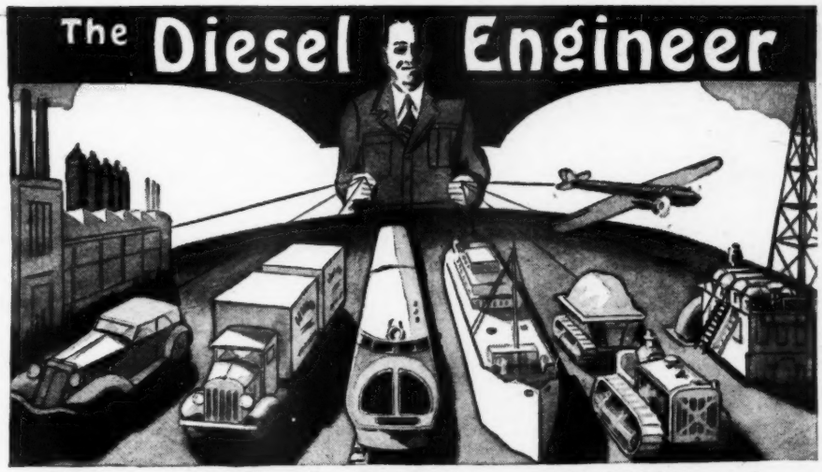

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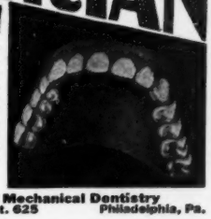

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Secrets of Success

keeps him working toward it systematically—each step in his career a step toward that goal. It has taken Harry Southern about nine years to progress to his present position. But his plan is right—it is working—each move has been an advancement, carefully thought out before it was made. And who knows to what new heights he will now rise?

All too frequently we see men take jobs merely because the starting pay is given more consideration than future opportunity. Then we see the men stick in a rut. Such would not be the case if the job were accepted only if it fit into a carefully planned success program. In many cases it would be far better to accept a lower paying job which offers either an opportunity for advancement or valuable experience. It is impossible to attach too much importance to the matter of thinking out the whole plan first—then sticking to it, come what may.

Another thing is courage. The plan can't always work smoothly. There are obstacles which must be overcome. Things looked mighty dark for Southern on many occasions. But never once did he lose his nerve. His courage came to the front. He didn't expect his success to come overnight—he knew it would take time. He met the problems—overcame them, one by one—and went forward to success.

We do not know what plans Southern has for the future, because even to his closest friends he seldom reveals his thoughts and ambitions. They are his secrets, only to be revealed after they are accomplished. But above all—he was willing to work and study to achieve success.

Harry Southern, since he started his radio career, has traveled close to 100,000 miles. He has operated two ship radio stations and three radio broadcast stations. He has made many friends—met many worthwhile persons. He has obtained his Bachelor of Science degree in Electrical Engineering. And radio has meant as much to him in health and happiness as it has in financial returns.

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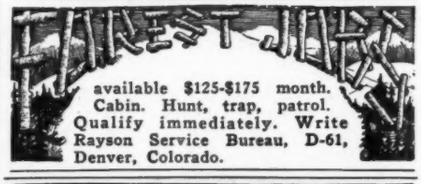

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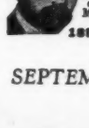

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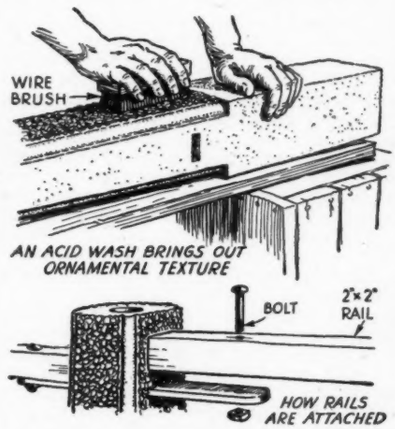
DURABLE GARDEN FENCE HAS CONCRETE POSTS

(Continued from page 60)

ground or on two sawhorses or boxes for convenience in the next operation.

Apply 1 part muriatic acid and 1 part water to the flat surfaces with a stiff wire brush to remove the surface cement from the clean, sparkling surfaces of the gravel, but do not brush the round surfaces of the corners at all. After you have obtained the desired effect, which should be approximately that shown in the accompanying photographs, scrub the surfaces well with plenty of water and an ordinary scrubbing brush to stop the action of the acid. Patch any defects with thin cement.

Leave the post on the board until the next day, meanwhile casting another in the form. The finished post may then be set in the



Sketches showing how posts are cleaned with muriatic acid and method of fastening rails

ground or put aside until wanted. If the weather is hot and the posts are stored in the sun, it is well to cover them with old sacks, which should be wetted thoroughly at intervals for a few days. Several forms can be made, if desired, to speed up the work.

For rail supports, use 8 by ⅞ by 3/16-in. strap iron with 5/16-in. holes drilled about ½ in. from the ends. The rails are bolted to them with 2½ by 5/16-in. carriage bolts. For corner posts or gateposts, special iron supports may be made by sawing the strap iron into two pieces and setting them into the open or top surface of the post while it is still wet.

The rails are 2 by 2-in. cypress. Fir or yellow pine 2 by 4's ripped down the center would be cheaper, but not so durable. The pickets are 1 by 2-in. cypress or ordinary furring strips. The spacing will be determined by the size of your yard. I set the posts 6 ft. apart on centers and bought the rails in 12-ft. lengths. The rails and long pickets are painted apple green, the short pickets cream color. Give the pickets several coats of paint before nailing them with 8-penny common nails.

The top ornaments for the posts were cast in the canopy or upper part of a discarded electric center ceiling fixture. This was well oiled and filled with a mixture of equal parts fine sand and cement. A bolt about 3½ in. long or an iron rod is set in the mix to project about 1½ in. The finished ornaments are fastened to the posts by filling the hole left by the top core piece with very wet cement and pushing the projecting bolt or rod into it.

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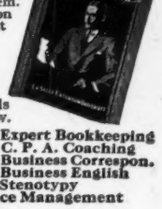

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AMATEUR PILOT SETS RECORD OF 2,000 DAILY FLIGHTS

(Continued from page 15)

every safeguard developed by aeronautical science on his planes to guarantee safe flying. Although known as a man who dares to fly in any sort of weather, he believes he can fly securely in fog and storm because his ships are equipped with radio, and he can follow a radio beam as skillfully as an experienced pilot on a transcontinental airliner. Often he guides his plane for long distances, following the buzzing on-course signals of a radio beam.

STREAMLINED pants adorn the wheels of his newer ships. These devices add seven or eight miles an hour to the speed of the planes. His oldest ship, the one in which he made the first of his "official" daily flights, zips through the air faster by five miles an hour since he installed a resistance-reducing ring, developed by the National Advisory Committee for Aeronautics, around the radial engine. His newest craft, a trim little three-place cabin monoplane, settles down to a very slow landing when Brock winds down wing flaps, which serve as air brakes. Similar flaps are planned for his older planes. He has wired thermometers to wing struts, just outside the cabin where he can see them. A quick glance at the mercury column tells him whether ice may be forming on the propeller or wings.

Every gadget that comes along finds a place on his planes, provided its use may result in higher speed and greater economy. He watches gasoline consumption closely. Seldom does he have to fill his tanks during a 540-mile round trip between his office and ranch. Recently, he has been making that journey on twenty-four gallons of gas. He sometimes returns to Kansas City with only a gallon or so to spare. He hasn't been forced down in an out-of-the-way Missouri corn field yet, but on two other occasions he missed his gasoline calculations and came to earth before reaching the end of his journey.

Two years ago, Brock entered a sportsmen-pilots' handicap race from Daytona Beach to Miami, Fla. After the top speeds of all seventy-four contesting planes had been determined, he found himself seventy-second in the starting line-up. So fast was his little monoplane, that he had passed the leader at Fort Lauderdale, only to hear his engine sputter and stop over the business district of Hollywood, Fla. He stuck the ship's nose down and landed on the nearest level spot, a swampy field the width of a city lot and less than a block long. As he set his brakes and brought the plane to a quick stop, he shouted to a farmer for help. In a rickety buggy, the pair drove six blocks for gasoline and, twenty minutes later, Brock took off to complete the race—last. Here was one occasion when a miscalculation drove him to earth within fifteen miles of a $1,200 bag of gold, which went to the pilot of a slower ship.

SOME time later, he took off from Kansas City on a flight to the Pacific Coast. After landing at Clayton, N. Mex., for gas, he again roared westward, anticipating an uneventful hop over the mountains. Two storms drove him into wide detours, requiring more fuel than he had anticipated. After rounding the second group of rolling rain clouds, he eased back on the stick and began climbing. Slowly the little plane rose, until his altimeter showed 15,000 feet. He leveled off, watching the peaks slide under his wings. When he chanced to glance at his gasoline gauge, he saw the float resting on the bottom. The tank was empty! A moment later, the engine sputtered and died. Gently, he nursed the ship over one more ridge. In the distance, he could see the field at Santa Fe. Then he began the delicate job of stretching a glide, a particularly hazardous maneuver when undertaken close to jagged ridges, and managed to reach the airport after an almost continuous stall of seven miles.

The most trying flight recorded in his log book was made between Washington, D. C., and Uniontown, Pa., after Brock had visited the nation's capital recently to receive from Federal and civilian aviation authorities a certificate of merit attesting his achievement in completing 2,000 daily flights without mishap.

Brock and Tex LaGrone, a veteran pilot who first encouraged Brock to try his wings fourteen years ago, took off in two of the amateur's planes. One was equipped with instruments for blind flying, but the other was not. The fliers got away in late afternoon, planning to reach Uniontown, 175 miles distant, before dark. When fifty miles from their destination, Brock saw fog closing down over the peaks ahead. He could pull up through and fly over the storm, or turn back. Since LaGrone's ship had no instruments, he chose the latter course.

AS HE swung the little ship around, he saw the ridge over which they had flown only a few minutes earlier disappear in clouds sweeping down from the north. Caught in a pocket between two ranges, hemmed in from above by a cloud blanket whose thickness he could not guess, he banked sharply and turned again toward Uniontown. Just as he was about to pull up, hoping his fellow pilot could find some way out of a terrifying situation, Brock saw ahead the opening of a tunnel between rocks and clouds. A few seconds later, his plane plunged into the narrow passageway, and for a mile the two planes roared westward, scarcely twenty-five feet above the winding roadway, their wings gathering moisture from the lower edge of the clouds, wing tips threatening to collide with trees on the cliffs. Twenty minutes after roaring out of the aerial subway, the pilots disembarked at their planned destination, safe after having gone through one of the "tightest" flights of any aviator's experience.

Oddly, while he has faced death in the air more than once, Brock considers that an experience on the ground held the greatest potential danger. He set his ship down easily on a green-carpeted Oklahoma pasture, one day. As he climbed from the cockpit, he heard a voice command, "Go!" Turning, Brock looked into the determined eyes of an Indian woman.

"What's the matter?" he asked.

"Go!" she repeated. "Me shoot."

FROM behind her back she drew a double-barreled shot gun.

"O. K.," Brock replied. "Me go." And he went.

Cheaper planes and more airports are Brock's solution for the problems of private flying. "The ships now being built are as cheap as can be expected with the present demand, but that demand can be increased easily by constructing more airports," he declared.

"How many?" I inquired.

"Fifty thousand! Yes, sir, fifty thousand. We have in the United States only 2,326 airports of all kinds and descriptions, and of these no more than 683 are lighted. That would give us a lot of airports, I admit, but they would provide fine landing facilities and encourage flying. Too, we should have at least 100 ports in each state provided with lighting facilities. Every state highway should be paralleled by landing strips at ten-mile intervals; strips, say, 300 feet wide and a half-mile long."

Brock recently *(Continued on page 99)*

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AMATEUR PILOT MAKES 2,000 DAILY FLIGHTS

(Continued from page 98)

demonstrated his own theory that adequate facilities will encourage not only general air travel, but also private ownership of planes. He arranged a tour of thirty-eight airplanes around Missouri. To each town he addressed letters to the local chamber of commerce and mayor advising them of the tour, giving them a list of notables who would like to visit the community.

"When these fellows began to pour in letters urging us to come to their towns," he said, "I replied, 'Sorry, but we can't land there; you have no airport.' Get the point?"

Soon Missouri's total of thirty-seven landing fields, including ten which can be really classed as airports, will be augmented, because Brock's subtle methods are driving home to scattered communities the need for fields.

This man does not stop with preachments. He demonstrates to his neighbors by personal example the benefits that isolated towns and villages would reap from installation of simple landing facilities, places where a pilot could drop out of the sky, fill up the tanks with gasoline, telephone a message or two, grab a sandwich, and be off on his aerial jaunt. Twice weekly he jumps into one of his three planes, snaps the radiophones over his ears, hops off from the Kansas City airport and makes a round trip to his 2,700-acre ranch down near Koshkonong.

BROCK first leveled a landing field down in a hollow on the ranch. Rains occasionally gave him a little trouble in landing, so he built a second, on higher ground. The other day, he flew down to celebrate privately the completion of the second field, only to find a crowd of neighbors awaiting his arrival. One long-time resident of the community asked the flier, when he had descended from the cabin of his comfortable plane, how long it took him to fly in from Kansas City.

"An hour and forty-five minutes," Brock told him.

"Pretty good," came the reply. "I hold a record myself. I was the first man to drive a wagon here from Kansas City, nigh onto sixty years ago. Made it in eleven days."

Brock makes the logical point that airlines will be to the towns and cities of the nation what stage lines and, later, railroads have been in the past. For instance:

"Two great air lines cross several mid-continent states. The Department of Commerce has equipped these airways, as part of a national system, with revolving beacons along the courses at intervals of approximately ten miles, and emergency landing fields every fifty miles. These emergency fields are representative of the type each community throughout the United States having a population of as many as 1,000 persons should own and have available for use. The time must arrive soon when the town of 1,000 people without an airport will be as 'backwoodsy' as the same town would be today without a garage.

"Throughout the country the air lines serve only the larger cities. Flying off the airways might very well be compared to driving a motorcar over a trackless waste. Private flying will expand rapidly only as those wastes are 'paved' with airports."

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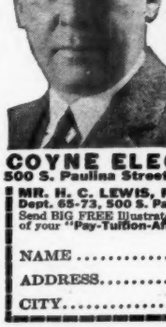

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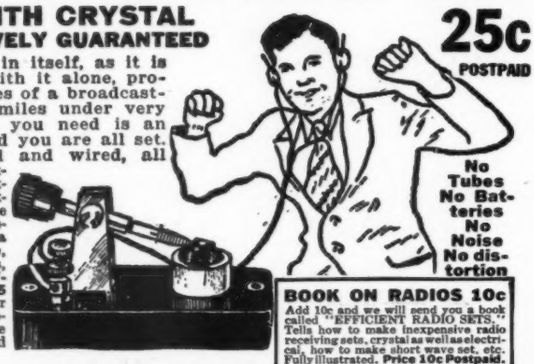

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HERE'S THE ANSWER

(Continued from page 55)

cules becomes less. If it were possible to cool matter to absolute zero, or minus 273 degrees Centigrade, there would be no heat remaining and no molecular motion. The matter would shrink in size but it would not disappear. In other words, heat is energy added to matter but it is not matter.

It's an Owl Myth

B. G., LOWELL, MASS. Owls do see in the daytime. Stories telling of their ability to see only at night are fables of natural history.

Small at Their Biggest

Q.—HOW big is a molecule?—J. O. F., Buffalo, N. Y.

A.—MOLECULES vary in size according to the substance. In air, some twenty seven trillion molecules are contained in a cubic centimeter. Their diminutive size is shown by the fact that this many grains of ordinary sand would fill a giant bin measuring one mile high, one mile long, and one mile wide.

At Home in a Trunk

A. C., TROY, N. Y. The baobab tree of Rhodesia, Africa, often grows to a circumference of 100 feet at the base. Because the wood is soft, natives frequently hollow out the trunks of these trees to form their homes.

Earth on Long Spin

Q.—WHAT force keeps the earth rotating on its axis?—E. K., Paterson, N. J.

A.—THE spinning motion of the earth was imparted to it at the time of its birth and it will continue rotating as long as no external force is applied to stop it. The pull of the tides as a braking force is so slight that its effect is negligible.

Cement for the Aquarium

T. H., BOSTON, MASS. A good aquarium cement can be made of the following ingredients: Litharge, three parts; fine white sand, three parts; plaster of Paris, three parts; linseed oil and drier, enough to mix. Mix the first three ingredients and then add sufficient linseed oil to make a smooth paste. Next add a small amount of drier. The mixture should be allowed to stand a few hours before using.

Good Ocean View

Q.—IS THERE a point in America from which both the Atlantic and the Pacific oceans can be seen?—H. M. W., Gary, Ind.

A.—THE Pacific Ocean and the Caribbean Sea, regarded as a part of the Atlantic Ocean, can be seen from the top of Mt. Izaru in Costa Rica when the visibility is good. Mt. Izaru has an altitude of 11,200 feet.

Plus or Minus Raindrops

C. R., MARQUETTE, MICH. The enormously large electric voltages created during thunderstorms are made possible, according to a recent theory, by air currents and the formation of raindrops. The swiftly rising air currents carry positive charges to great heights while the negative charges fix themselves to raindrops and fall. The electric potentials, amounting to millions of volts, finally break through, causing the lightning flash. The electric polarity of a raindrop depends, according to this theory, on whether a raindrop is getting smaller by evaporation or growing by condensation. It is positive on the evaporating drops and negative on the growing drops. Rain carries negative electricity because the raindrops usually grow larger as they fall.

SYMPHONY ORCHESTRAS FOR EVERYBODY

(Continued from page 37)

For the most part, we played waltzes, galops, polkas, and schottishes, for ours was strictly a dance orchestra and our favorite selections came from a bright red book labeled, "Gems Of The Ballroom." But we were Rochelle's only orchestra. Today, my home-town high school boasts an orchestra of fifty musicians who can and do play the classics although they do not feel above light operas. The development of worth-while orchestra performances is even better illustrated by Ottawa's story.

That little Illinois corn-belt city had the honor of acting as host to the 1934 National High School Orchestra Contest because, away back in 1920, a young fellow named C. R. Peacock had come out of the East to serve as public-school basket-ball and track coach, assistant football coach, Boy Scout executive, director of boys' and girls' glee clubs—and creator of a high-school band and orchestra.

PEACOCK had found no band in Ottawa's schools. Nine bungling youngsters were the nucleus of the orchestra. Peacock called a meeting of public-school music lovers; assembled twenty boys and girls who wanted to play; persuaded their parents to purchase instruments; arranged his raw pupils into string, wood-wind, brass, and percussion sections, and went into action. His method of teaching was characteristic of that now followed in so many public schools. He started from scratch and kept on going.

"Each violin player," he began, "must hold his violin in his left hand with the chin rest on his left collar bone, as I do. He must hold the violin bow in his right hand, four fingers resting on top of the grip, the thumb nestling beneath it and in front of the frog—just like this. Always keep your bow at right angles to the finger board. You can do this by bending your wrist, keeping it always flexible—so. Thus you are less liable to make squeaky sounds. Watch yourself in a mirror until your perfect position becomes a habit."

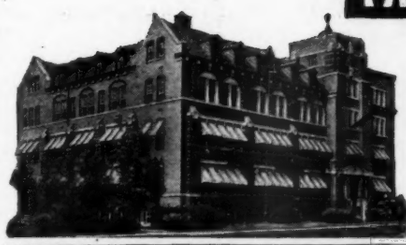
The cello players were shown how to play in a sitting position, the cello resting against the knees, the player's head to the right of the pegs. The string-bass players were taught to stand behind their bull fiddles, the left leg forward, bracing the instrument. The wood-wind or reed-instrument players were given fundamental instructions. The drummers were instructed in handling sticks and calfskins.

Then Peacock started each section on some simple tunes and exercises. Members of each section competed for the "first chair" or section leadership. Each section became a jury, deciding by raising hands which member was the most able player. Finally, all the sections were brought together. The Ottawa High School Orchestra became a reality.

BY 1934, Peacock was conducting a symphony orchestra of more than a hundred high-school students; his boys' band of nearly seventy pieces had been taken over and financed by the city; he had aided in establishing a Civic Orchestra, as well as a good orchestra in each of Ottawa's Sunday schools; he had graduated dozens of players into the Ottawa University Orchestra; and his high-school aggregation of symphonic players was competing for the high-school championship of the United States. It won first honors in its class.

Since music made by stringed instruments has always been the favorite of discerning individuals, it is not strange that, while drum corps have throbbed and bands have boomed, our comparatively subdued and technically delicate orchestras began increasing in size, skill, and numbers, several years before the National High School Band was first assembled in 1926. Yet, *(Continued on page 102)*

High School Course in 2 Years



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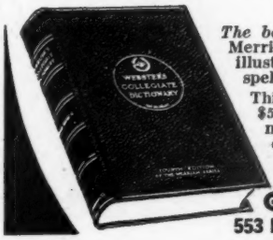

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SYMPHONY ORCHESTRAS FOR EVERYBODY

(Continued from page 101)

like the thriving bands and drum corps, our high-school orchestras have been developed largely through competition.

The orchestra movement started at Richmond, Ind., in 1922 when the first All-State High School Orchestra played a genuine symphony under the direction of "Joe" Maddy, professor of music at the University of Michigan, before a music supervisors' and teachers' convention. That orchestra was a result of elimination contests. Members of village and city high-school orchestras were selected by contests or competitions. Then the best orchestra in each locality was chosen. The best players in these selected orchestras were asked to meet at Richmond as the All-State High School Orchestra of Indiana. Final selection of members by instruments, to give the orchestra its proper tonal balance, was made by Maddy, father of the all-state idea.

FOUR years later, in 1926, Edgar B. Gordon, head of public-school music in the University of Wisconsin, and others working with Joe Maddy had so expanded the all-state and contest idea that 230 boys and girls representing the best high-school orchestral players in thirty states assembled at Detroit and, as the first known National High School Orchestra, successfully interpreted the "Eroica" Symphony, under the direction of Ossip Gabrilowitsch, after only four days rehearsal —to the surprise and delight of the Music Supervisors' National Conference. Each succeeding year saw new triumphs.

But while the National was working miracles, its creator knew that its members were not well enough acquainted. Symphonic players should rehearse together during long periods. Hence, by 1928, Maddy had borrowed $20,000, spent $25,000 on his National Music Camp at Interlochen, Mich., and finished his first season $40,000 in the red. Since then the National has never missed a season. It now owns improved property worth $230,000. Foundations, corporations, and public-spirited individuals have aided it financially, but most of its income has been in tuitions—$175.00 this year for each student.

In a pine woodland between two blue lakes, more than 100 boys and girls from high schools of more than half our states meet for eight weeks of musical, spiritual, and physical development under the tutelage of several of our nationally known directors of symphony orchestras.

Fifteen-year-old Jean Root arrives from Ashton, Ill., tenderly nursing a violin. Vance Beach appears from Emporia, Kans., bearing a cello carefully wrapped. Thomas Scott, representing the high school of Newton Highlands, Mass., smilingly convoys his precious flute. Sixteen-year-old Johnny Biggerstaff totes his oboe from Kirksville, Mo. His schoolfellows have kidded him because it is a tradition that all oboe players become "nutty" from holding their breath while vibrating the oboe's delicate double reed of Senegalese sugar cane. But Johnny doesn't care. He and other musically adept boys are assigned, by mature counsellors, to rustic cottages on the shore of Lake Wah-Be-Ka-Ness (Water Lingers).

SEVENTEEN-YEAR-OLD Mary M. Campbell brings her string bass, or bull fiddle, from Minneapolis, Minn. Some of the boys call her giant fiddle a "dog house" and remind her that the once celebrated prize-fighter, Jack Johnson, trained on one. She smiles serenely, undisturbed by all this joshing. Fourteen-year-old Betty Ann Pitts is on hand from Omaha, Neb., for two months' study of voice and piano. Winifred Pregill, specialist in clarinet and slide trombone, travels all the way from Honolulu, Hawaii. Dorothy Brock hails from Richmond, Ky., with her trumpet and French horn. Josephine Ferraro bears greetings from her high-school friends of Utica, N. Y. These girls join scores of others in cottages facing the other lake, a half mile from the boys' encampment.

Many of these youthful music lovers reach Interlochen only after physical and financial sacrifices. Hours and years of practice have improved them musically. Days and months of hustling have helped them earn their camp expenses.

A doctor in South Dakota once sent Joe Maddy a check for $150. The tuition was then $300.

"My boy has been selected for Interlochen," he wrote, "but this is all the money I can raise for him. Will you accept my note for the balance?" A note was sent for his signature. Several weeks elapsed with no word from him. Then the doctor sent another check for $150 explaining, "I gave my boy some of my oldest past-due bills and told him he could have $150 if he collected it. That boy collected $450. When he gets back from camp I'll make him my official collector."

Another boy was selected from near Saranac Lake, N. Y. He hadn't a penny. He started a milk route and made the money. Another boy hitch-hiked from Massachusetts, carrying his baggage and his trumpet. By playing it on the highways, he literally blew himself half way across the continent. But most of the boys and girls are financially sponsored by their parents and their communities.

In some cases, the camp student's community raises money by benefit concerts, suppers, and various entertainments. It's a civic affair. A home-town boy has made good.

Young people become attached to different types of musical instruments through family tradition, through natural inclination after observing some musician playing, or through a teacher's guidance. Highly emotional individuals make the best violinists. But a fine sense of pitch also is necessary.

A boy may choose to be a flutist because he is mechanically minded, is not afraid of a multiplicity of keys, can read a cadenza of 120 notes at a glance, and does not hesitate to tackle it. Former Vice-President Charles G. Dawes played his way through college on a flute. Incidentally, a good whistler is apt to be a good flute player.

AN UNCONSCIOUS sense of showmanship explains many a slide-trombone player. But he has to be just as sensitive to tonal altitude as does the violinist. The slide of the trombone must stop in one of seven "positions." Only the player's ear can tell him whether he is playing true notes or blue notes. Hence, many a young trombone player is transferred to a keyed instrument, on which the pitch is fixed mechanically either by valves or by keys.

Girls are inclined to favor bass instruments. A 120-pound miss will swing a mean bow across the strings of a bass viol which weighs thirty pounds, stands seventy-seven inches on its wooden legs, and is fifteen inches through the waist and nearly twenty-four inches across its lower end.

And so, young Americans are learning how much more pleasure there is in making good music than in listening passively to the performances of others. Music critics foresee an improvement in our musical taste, because actual playing is the surest way to an appreciation of the best in music. In spite of the great progress already made, observers say that the amateur-orchestra movement is only beginning, and that we soon shall have symphony orchestras for all who care to join them.

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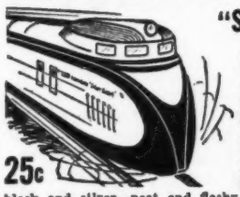

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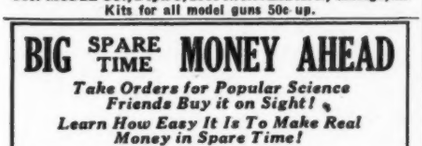

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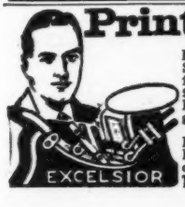

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NEW WAYS FOR MAKING OXYGEN AND HYDROGEN

(Continued from page 51)

central tube. In doing so, it should carry a drop of sodium hydroxide solution with it. The medicine dropper should therefore be adjusted up or down, so that the liquid will enter the lower end of the central tube and a drop will be carried upwards, pushed by a bubble of gas.

As the gas bubble leaves the top of this tube, the drop of sodium hydroxide solution falls upon the gas beads or chips. The latter soon become covered with the solution and, as the gas must pass downward among the beads to reach the outlet tube, the carbon dioxide contained in the gas is effectually absorbed by the large surface of caustic liquid thus exposed. Pure hydrogen comes from the outlet.

Meanwhile, any excess of sodium hydroxide solution carried to the top of the scrubber runs back to the lower part through the short tube in the middle stopper. Thus the scrubber is automatic in operation, the liquid being circulated again and again over the absorbing surfaces of glass.

BY FILLING your scrubbing bottle with plain water or weak acids, you can remove an alkaline gas such as ammonia from gas mixtures. Sodium hydroxide solution, on the other hand, removes acid-forming gases, of which carbon dioxide is one example. Others are sulphur dioxide and hydrogen sulphate. Either of these two gases, like carbon dioxide, will interact with magnesium and water to form hydrogen, and the resulting gas may be purified with the scrubbing bottle in the same manner. The scrubber should be washed thoroughly after use, as alkali will attack glass.

If a good source of heat is available, hydrogen may be generated from such commonplace materials as iron tacks, nails or steel wool and water. Assemble the following apparatus: Place a glass flask containing water on a heating stand over an alcohol lamp. The flask should be provided with a one-hole cork in which is inserted a short L-shaped glass tube.

The other end of this glass tube fits into a short length of one-half-inch gas pipe which has been fitted with one-hole stoppers at each end. Prior to corking the pipe, place the iron tacks or nails in it. The pipe, when in position, should be supported at a right angle to the top of the flask to which it is now connected.

The far end of the gas pipe has a short piece of straight glass tubing inserted in its cork. From this, a rubber tubing should lead to a collecting bottle in a pneumatic trough.

Next, place one or more Bunsen burners under the gas pipe so that the flames will heat the full length of the pipe. A flame-spreading attachment will be helpful in accomplishing this. Wet cloths can be placed around the stoppers to keep them cool.

Light the alcohol lamp and start the water boiling in the flask. Do not generate the steam too rapidly. Heat the pipe thoroughly with the Bunsen-burner flames. Wait several minutes before collecting the gas so as to displace all the air in the apparatus.

The oxygen of the water (steam) combines with the hot iron to form iron oxide and the liberated hydrogen gas passes over to the collecting bottle. Zinc can be substituted for the iron, if desired.

CAVE YIELDS REMAINS OF PRIMITIVE MINER

DISCOVERY of the remains of a prehistoric miner, pinned by a falling bowlder as he worked in the depths of Mammoth Cave, Kentucky, may shed new light on the earliest of Americans. Archaeologists plan to search the surrounding sands for tools, garments, and other implements.

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GREATEST CRIME LABORATORY AIDS NATION-WIDE MAN HUNTS

(Continued from page 13)

In addition there is a loose-leaf book showing the most common tread patterns as an aid to identifying tracks left by criminals. Photographs and casts of such tracks are sometimes forwarded to the laboratory for identification.

Another metal case, with hundreds of tiny compartments, is filled with shells and bullets, one of every kind made in America. A special drawer in this cabinet holds 125 shells and bullets, each of which has figured in a murder. When the guns of suspects are brought in, bullets are fired through them and the markings left on the lead by the barrels are compared with the markings on the fatal bullets. In this way, puzzling crimes are solved.

SINCE last year, customs officials have been reporting each shipment of guns coming into the country from abroad. This helps the Department of Justice men trace the ownership of underworld weapons. In the laboratory, there is a fast-growing collection of firearms. It now holds 125 different American and foreign weapons.

It is such catalogued reference material that makes possible the high-speed efficiency of the Division of Investigation—an efficiency that promises to make it a legend in the future as Scotland Yard has been a legend in the past.

Note how this efficiency functions in action. Shortly before my visit to the laboratory, six men, with revolvers and automatics ready, walked into a New Jersey bank, cowed depositors and employees, and sped away with a $9,750 haul. Since last year, G-men have had authority in Federal Reserve bank robberies and they were prepared for such an emergency.

As eyewitnesses described the robbers, government detectives checked off distinguishing characteristics on a printed sheet. A few hours later, a long black machine in the Department of Justice laboratory began to chatter. Through it poured 400 punched cards a minute. Each card represented a known bank robber. As the machine came to a card recording similar characteristics to one of the described men, it kicked it out into a receiving tray.

Twelve thousand cards ran through the machine before the task was over. Sixty lay in the tray when the job was done. Rapidly, the photographs of the men represented by the sixty cards were taken from the files, packed, and forwarded to the G-man in the field.

Within a short time, while their impressions were fresh, the eyewitnesses were running over the sixty pictures—narrowing down the search to less than a dozen men. Organization had concentrated the pursuit and saved untold hours for Government sleuths.

WHEN a criminal like the late John Dillinger can leave a Florida hideout one day, rob a bank in Indiana the next, and be reveling with his gang in Arizona twenty-four hours later—as J. Edgar Hoover points out actually happened—the speed of the modern criminal has to be matched by split-second work on the part of the police. Minutes are vital. It is the speed with which the Department of Justice functions that accounts, in a large measure, for the spectacular success of the Government crime fighters.

Another step in this direction is the single-fingerprint system which has been established at the laboratory. Twelve thousand kidnapers, extortioners, gangsters, and bank robbers are catalogued in this list of public enemies. Prints of each finger are filed separately, in addition to the usual methods of classifying all ten fingerprints as a group. One fingerprint on the trigger of an underworld gun, not long ago, solved four murders through the work of the new system.

This system is entirely separate from the huge 5,000,000-fingerprint collection, the largest in the world, which the Division of Investigation has built up as part of its scientific crime-detection machine. It started with a few thousand prints from Leavenworth penitentiary, Kansas, and is still growing at the rate of more than 2,000 fingerprints a day. Field men frequently send in objects for the laboratory experts to examine for latent fingerprints. Bottles and the rear-view mirrors on getaway cars are the most fertile sources.

As a central clearing house for fingerprints, the laboratory is proving of increasing value. For instance, about the time I was there, an air-mail letter brought in fingerprints of a man arrested on the Pacific Coast for petty larceny. A quick check was followed by a wire to a Middle Western prison. The man was an escaped convict wanted at the penitentiary.

In such checking, the long, black sorting machine is again called into play. Punch-holes in the cards record the various patterns of fingerprints and the patterns most nearly like the one sent in are weeded out for close examination.

Not so many years ago, fingerprinting was looked upon merely as part of the fiction writer's bag of tricks. Now, it is firmly established as a means of identification. In a similar way, other scientific methods are gaining recognition.

One of them is the use of moulage. This plastic substance was invented by an Austrian criminologist. With it, the detective can make molds that will preserve perishable evidence. So delicate is the moulage that it will record such tiny bits of evidence as fingerprints, and tooth marks in fruits and foods. A special table, equipped with grinders and electric hot plates, provides facilities for the experts of the Washington laboratory.

IN ANOTHER room, partitioned off with black hanging curtains, you see a battery of ultra-violet lamps for testing chemicals, studying dust, and searching for invisible writing. Research microscopes magnify to more than 2,500 diameters and a complicated microprojector throws enlarged images of hairs and fibers on a screen for study by the scientists. Incidentally, the microanalysis of fibers is coming to be an important branch of the laboratory work.

Some months ago, government detectives found a fine raveling of red wool, a tiny and easily overlooked clew, clinging to a window sill after a robbery. Carefully wrapped in paper, it was forwarded to Washington. Here, the laboratory men compared it with threads taken from the wool sweater of a suspect. They matched exactly. This piece of scientific evidence played its part in convicting the guilty man.

So fascinating is the work of this new scientific crime-detection laboratory that already guides are having to take visitors through at special hours. Twice a day, at 10:30 a.m. and at 2:30 p.m., the tours begin. Often as many as 200 persons at a time make the trip.

A few years ago, a famous scientific detective of Europe made the observation: "A lawbreaker always signs his crime. If the detective is clever enough, he can read the signature." J. Edgar Hoover expressed the same idea to me more succinctly when he said: "There's a crack in every crime".

By turning to science, the government detectives are ferreting out these hidden flaws, these obscure signatures of the criminal. The most spectacular phase of their mass attack upon organized crime is the new laboratory at Washington. It marks an important milestone in the progress of criminology.

ELECTRICITY CONQUERS THE ARCTIC

(Continued from page 35)

a fairly accurate idea of the mineral wealth of Lapland became known. It surpassed the wildest dreams of all concerned and spurred on the enormous scientific works in the barren wildernesses of the far north.

It was found that more than one billion tons of the highest grade iron ore in the world lay within a five-mile radius that was in time to become the backyard of Kiruna, the new wonder city of the Arctic. Nearly one billion tons more lay in the surrounding districts of Lapland! Lapland ore averages sixty percent pure iron, whereas the world average of ore purity is forty-four percent. An eager world market awaited this ore in unlimited quantities for the manufacture of the highest-grade "Swedish steel" products.

SEVERAL years later, borings made by the latest-type machinery failed to reach the bottom of the deposit at a half mile. At this rate, working these mines to the limit with the highest-powered and most efficient machinery, it would take more than 200 years to reach the end of the supply. There remained nothing to do but to wait for the promised electric power.

Porjus Falls, on the Lule River, was selected as the source of the electrification of barren Lapland. A concrete dam was constructed to hold back the river thirty feet above its old level and give it a "head" varying from 180.4 to 190 feet. This dam was 4,100 feet long. A rock basin was excavated and an intake tunnel 1,723 feet long was drilled to a roofed-over reservoir of five chambers that could be separately cut off by sluice gates. From these chambers penstocks were run, each built into 164-foot shafts leading into the generator sets. Since the water was thus carried through solid rock from intake to tail-water, freezing was completely avoided even in the most severe periods of arctic weather.

The completed Porjus plant is practically invisible, save for the switch house and engineers' quarters that appear above ground. An electric elevator takes one down 160 feet to the power house, a vaultlike room blasted out of solid rock, permanently out of reach of the arctic frost that prevails half the year in the open air above ground. The dimensions of the machinery hall are thirty-three by 302 feet. Its elongated shape gives it the appearance of the crypt of some vast cathedral dedicated to the worship of the gods of light and power. It is built within a shell of reënforced concrete, standing free from the surrounding rock, so that moisture cannot penetrate its walls. The natural heat from the dynamos keeps the interior pleasantly warm the year round. Through the tunnels in the surrounding rock roars the mass of water that drives the horizontal turbines. The converted power passes out through the network of colored cables less than an inch in diameter, on a thousand missions of energy, heat, and power.

COMPARED with Sweden as a whole, which reckons on 1,000,000 horsepower, the available supply of Lapland is estimated at 650,000, of which Porjus and near-by plants can be made to produce more than 300,000. Approximately one third of the hydroelectric energy of the nation has thus been rendered possible by this conversion of arctic Lapland. The Lule River drains a chain of lakes that reach high up into the mountains all the way to the Norwegian border. These serve as a storehouse holding more than a billion cubic yards of water for the Porjus works, to be used as the season requires.

The visitor is taken about the plant by the engineer in charge, who sums up the situation in the control room: "If I pressed this button," he explains, "all the trains in Lapland would instantly stop. Again, if I pressed this second button, all mining operations would come to a standstill. And if I pressed the third button, every home, store, church, school, and public building, not only in the whole of Lapland, but in Narvik, Norway, 300 miles away, would be without heat and light."

In other words, should Lapland's scientific heart stop, Lapland would again go back into oblivion and semidarkness and become the primitive wilderness of almost lifeless frozen silence it had been for 100,000 years!

Instead, science and invention have given the civilized world the thriving city of Kiruna, a hundred miles north of the Arctic Circle and 850 miles north of Stockholm.

The city lies partially in the valley, partially on the mountainside. The mines themselves are among the most curious in the world. The ore was melted and came to the surface in some mighty prehistoric convulsion that raised two solid mountains of iron nearly a half mile in height. Mining is done by stripping—literally slicing down through these deposits. Ore and rock are extracted by blasting in stopes, or ledges, ranging in depth from thirty-three to sixty-six feet.

Three times every day, excepting Sundays, the town of Kiruna is shaken to its foundations. At 8:40 A.M. and again at 12:20 and 4:00 P.M., red flags are run up for miles around the blasting area. For a full ten minutes sirens shriek and wild alarms echo and reëcho through the hills. People can be seen running down the mountainside in every direction. Half the population stops its ears and braces itself for the crash and roar which is prolonged for ten to fifteen minutes.

The ore blasted loose by the explosions is loaded in flat-bottomed trucks carrying about thirty tons each. Five of these trucks form a train drawn by a locomotive driven by a 220-horsepower motor. The locomotives haul the ore to the side of the giant electrically driven crushers, where a crane seizes one side of each car and tips it until its contents slide into the mighty jaws. These crushers, themselves weighing 200 tons, crush blocks weighing up to ten tons of ore, reducing them to pieces about twelve inches square.

THE crushed ore drops through vertical shafts into a discharging mechanism operated by compressed air. This is located at the base of the mountain, at the end of a tunnel bored into it to the depth of one and one half miles. Here trains await the ore. Twenty cars are loaded in fifteen minutes, or at an average of forty-five seconds per car. Samples of ore are taken and the cars are weighed automatically, a full load being indicated by light and sound signals. Out of this tunnel emerge, each day, thirty loaded trains, each composed of twenty thirty-five-ton loads; a total of 600 cars. These cars are then turned over to the State Railways and made up into ore trains. At least twenty trains, each consisting of forty loaded cars drawn by a 2,200-horsepower electric locomotive, are sent out all through the day and night throughout the year, to Narvik, Norway, 105 miles to the north. These trains carry 7,000,000 tons of the world's highest grade iron ore to steel manufacturers every year. Germany, England, France, and the United States are the chief purchasers.

And so, where a few years ago there were only scattered reindeer trails, today we find the most northerly railroad in the world, second to none in point of up-to-date equipment. In less than twenty years the whole of Lapland will be intersected by a network of electrified railroads, reaching all the vast deposits as yet untouched, transforming desolate regions into prosperous mining fields.

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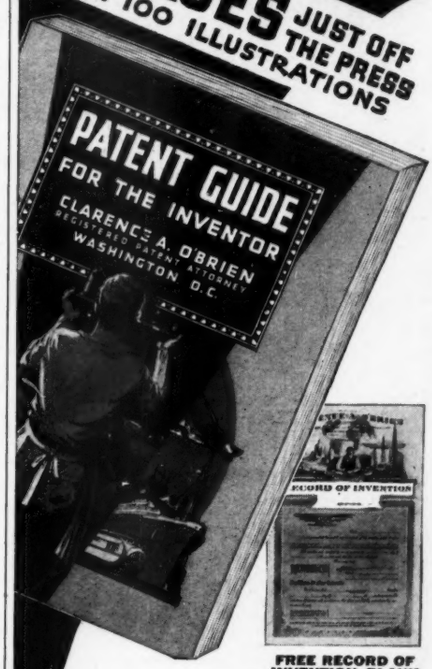

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WHAT ANIMALS KNOW ABOUT MEDICINE

(Continued from page 24)

get wild-lily roots, and the woodland caribou, in Manitoba, digging deep into the snowbanks to get the first green shoots of spring, and seeking moss along the bottoms of cliffs and around the cedar swamps.

"In the spring, every wild herbivorous animal migrates to the pastures where the first green grass appears," he says. "That grass is food, of course, but it's a tonic, too. The animal is smart enough to take it before he gets sick."

One experience, which convinced Dr. Deason that the health knowledge of animals may sometimes be very much superior to that of man, came to him in India where he studied eye surgery in the Government Hospital in Madras. "There were literally thousands of the natives suffering from cataracts and other eye diseases, who came to us for treatment," he relates, "and yet the monkeys, playing in the trees all around, never had eye sores. They protected themselves against the disease by eating fruits rich in vitamins, while the natives ate rice grown in fields that had been drained of vitality through ages of one-crop cultivation. That rice contained no vitamins. It was lifeless. You couldn't have persuaded a monkey to eat it."

CARNIVOROUS animals, of course, do not get vitamins from the same sources as herbivorous animals. When a mountain lion, a lynx, or a bobcat makes a kill, it first rips open the chest cavity and the abdomen of its prey to eat the liver and pancreas and other internal organs which we now know to be rich in vitamins. In Africa, Dr. Deason observed the same dietary preference among lions when he examined the carcasses of the zebras, hartebeests, and other animals which they had killed.

Yes, animals know instinctively the value of vitamins. They know what foods contain them, and they also know the value of sunlight, which provides vitamin D, the preventive of rickets. This knowledge, explains why they so seldom get sick.

When an animal does get sick, however, it knows that it probably needs, first of all, a laxative. That's exactly what the doctor usually prescribes first when he is called to treat a sick human being.

Every one has seen cats eat green grass, and especially catnip if they can get it, when they are suffering from any digestive troubles. Dogs, too, will eat certain kinds of grass under similar circumstances. These herbs act as laxatives for the meat eaters. Bears, which eat both meat and fruit, know certain berries which have a laxative action. In the Northwest, the black bears, when they come out of hibernation in the spring, hunt these berries to put themselves in condition.

Moose and deer, and other animals which normally live on herb diets, seldom need a laxative. More often they need just the opposite, some medicine which will slow down the action of the intestines. This medicine they find in the tender bark and twigs of oak and other trees, which contain tannic acid. Dr. Deason tells of seeing moose riding down young saplings to get at the topmost twigs, and deer standing on their hind legs for the same purpose. Domestic animals usually receive enough dry food, such as grain or hay, to keep them in condition when the grass is lush; but they will sometimes adopt the same measures as wild herb eaters when the necessity arises.

IN SPECIAL cases, animals often go on special diets. A recent study of the diet of the mule deer has disclosed that the female, in pregnancy, selects her food as carefully as any expectant mother of the human species under orders of a doctor. She eats plants that she avoids, more or less, at other times, and reduces her diet of other herbs that would commonly make up a large part of her fare.

Every trapper knows the difficulty of poisoning wolves and coyotes. When one of these animals suspects that he has eaten any poisonous substance, he immediately ejects the contents of his stomach. When a human takes poison, the doctor has to give an emetic or use a stomach pump; nature has enabled the wolf or coyote to achieve the same end by voluntary contraction of its stomach muscles.

An animal with a fever always hunts an airy, shady place near water, and remains very quiet, eating very little and drinking often, until it recovers. Our human physicians prescribe identically the same conditions for us, when we get a fever.

ON THE other hand, a rheumatic animal always hunts the hottest spot that it can find in the sunlight and soaks up all the heat possible. It seems to know instinctively what human doctors have discovered only in recent years—that heat stimulates the elimination processes of the body which carry off the poisons causing rheumatism and many other ailments.

Of all the safeguards against disease, none is more important than cleanliness. Humans have to be taught the value of personal hygiene, but wild animals practice it instinctively. The feline family, to which cats and lions and tigers belong, clean themselves carefully a dozen times or more a day. Elephants give themselves shower baths. Stags and many other animals bathe in streams and lakes at every opportunity. Birds, too, bathe frequently. When they get body parasites, they rid themselves of the pests with dust baths, mud, and clay.

When an animal is wounded, its first impulse is to clean its wound. No human physician ever works harder to keep out infection. Most animals use their tongues for the purpose, and the enzymes in the saliva act as a mild germicide. Of course, iodine, and other antiseptics used by human doctors, are stronger, but the principle is exactly the same. Wolves and other members of the canine family are also very careful not to let a scab form until all danger of infection is past.

If a wound does become infected, however, nature come to the rescue with an antiseptic agency of a most surprising kind. She brings the blowfly, which deposits eggs in the wound. The eggs hatch into small white maggots which eat away the putrefaction. They never attack the live tissue. The animals seem to be aware of the value of maggots, for an animal never disturbs the maggots that get into its sores.

THAT some creatures know enough to set broken bones, Dr. Deason is ready to testify from his own observation. He tells of a turkey, on his ranch in the Sierra Nevada Mountains, that got its wing broken. The bird was constantly concerned to keep the broken wing well up on the back, and, whenever it slipped out of place, always used the beak to readjust it with the utmost care.

"I'm confident," he says, "that animals know a lot more about medicine and the care of injuries than any of us have ever yet discovered. I have talked to a good many zoo keepers who have told me that, when an animal gets sick from any disease not easy to identify, they give it every shrub, fruit, and other edible substance that they can think of, which the animal might be able to find in its natural habitat. Usually, when such an assortment is placed before it, it can find the medicine it needs."

AMAZING MACHINES SPEED WORK OF MODERN LUMBERJACKS

(Continued from page 28)

other occasions, whipping gales threatened to tear loose the powerful chains binding the heavy logs together. Only expert seamanship and quick thinking got the raft into Santa Cruz, Calif. If it had broken up, it would have left thousands of logs, some 150 feet long, floating on the ocean to endanger shipping.

One man, John A. Fastabend, has constructed every raft launched on the Pacific coast since the first, containing 1,000,000 feet of timber and a heavy deck load, set sail. After that maiden voyage, the rafts grew rapidly in size. Today, each contains 5,000,000 feet of logs, plus sizable deck loads of smaller logs, shingles, spars, cedar poles, fence posts, laths, and, sometimes, machinery.

AS I stood on the floating derrick at the edge of Wallace Slough, on the Columbia River, observing a wooden boom laying logs nearly as long as the tallest forest trees in the cradle, it looked as though these unwieldy steel-girded rafts would pull apart from their own weight, particularly when pounded by heavy seas. I found, however, that there is a secret which explains the remarkable success of these raft builders.

"Great strength is built into the rafts from the beginning," Fastabend told me. "We are able to construct these big floating cigars, which come to a point at each end, by using the floating cradle. The cradle is built in sections. The inner side is moored to pilings securely anchored to the river bottom. The outer side is only loosely moored in position. When the cradle has served its purpose and the log raft has been formed, the outer side of the cradle is moved away. The raft then is free to start on its journey."

Tree-length logs constitute the greater part of the material in a raft. These are so heavy that the floating pontoon supporting the derrick sometimes is almost turned over by their weight. Long logs provide the powerful backbone which resists the action of the water while the logs are being laid in the cradle.

When a raft is half completed, a studded anchor chain, two and one-half inches in diameter, is run through the center from end to end. Other chains are shackled to this powerful center chain and attached to circle chains at the end of the raft. A towchain is then fastened to one of the circle chains to provide means for emergency towing. These chains alone equal the weight of 150 medium-size automobiles. The rafts are 1,000 feet long and have a draft of nearly twenty-five feet.

As a raft moves down the coast, the leading tug stands off slightly to one side, never directly in front. This "slanting" pull, plus a tow chain 185 feet long, serves as a shock absorber to take the jolts of high seas.

These present the more spectacular phases of logging. What is science doing to guarantee both the best present use of the forests and their future growth?

A visitor in an Oregan forest was surprised the other day to see a bronzed engineer standing in the sunlight filtering down through the trees, pointing a flash light toward the heavy growth near-by. He was one of a party of picked logging engineers mapping 30,000 acres within a single forest this summer in order that logging plans may be scientifically made.

THESE men set out on the summer's undertaking far from the nearest city. Pack horses, plodding through trackless stands of timber, bring their supplies. The engineers often cut their own trails as they proceed through the forest, surveying strips 440 feet wide. Frequently they take sights through dark woods and brush by means of a flash light. Behind each strip crew comes a sketcher who records everything he sees. When they finish their tedious job, the dozen men bring back to headquarters a detailed picture, from which plans are made for fitting logging machinery and railroads to the particular area.

After the surveyors come the logging crews, advancing like an army on known objectives. From topographical maps, engineers plan the transport system, involving a railroad or trucks, as the circumstances may dictate. Advance lumberjacks mark selected spar trees, chopping an "X" in the bark of each to save it from the fallers and buckers, the shock troops who fell the trees and clean up the logs.

No matter how rapidly these men may strip the forests of their finest trees, the U. S. Forest Service and private operators intend that such timber land shall be self-perpetuating. Novel methods of selective logging and restocking the land are now being put into effect. They seek to maintain the immature stands until the young trees attain full stature, to provide seed sources for areas logged off, and to prevent the spread of fires.

"WE ARE exempting smaller trees," I was told by an official of the West Coast Lumbermen's Association at Seattle, "cutting only those 150 years old or older. The next cut from the same lands will come in sixty to 120 years from now."

In an effort to hasten regrowth of forests, lumbermen have worked out several plans. Single trees; here an island, there a strip of young trees; double rows along creeks and single rows atop ridges—these are now left that seed may be carried by the winds onto logged-off areas. Within five years, under these methods, new stands will be sprouting.

Meanwhile, loggers see an ample supply of timber for several decades to come. Some of the trees cut in the Pacific Northwest are so large that a house could be built simply by hollowing out the trunk. Many Douglas fir logs come as large as twelve feet in diameter. These grow in thicker stands than do forests elsewhere. A Douglas-fir forest will yield eight times more lumber per acre than will a forest in the eastern or middle United States.

Forest economists say there are available today in the Pacific Northwest 1,141,000,000,000 board feet of timber—more than has been cut in the forests of New York, Pennsylvania, Michigan, Wisconsin, Minnesota, New Hampshire, Massachusetts, Maine, and Vermont since the Revolutionary War. Half of the nation's standing timber is on the Pacific slope, and more than half of this stands in Washington and Oregon. One fourth of all standing timber is Douglas fir. Of the 28,000,000 acres of original primeval forests in the Northwest, only one seventh has been logged.

LAKES ARE FERTILIZED TO INCREASE FISH LIFE

FERTILIZING a lake as a farmer fertilizes a field is a new method used by University of Wisconsin scientists to increase the number of fish in the water. Tests have been made in several small lakes in that state. The lime and phosphorus of the fertilizer stimulate the growth of marine plants, the experts report, just as they do land vegetation. This in turn increases the "marine pasturage" and results in increasing the size as well as the number of game fish in the lake. Previously, it had been found that stocking the lakes with fish failed because there was a lack of nourishing food. By reversing the procedure and increasing the available food, the scientists hope to restock the lake waters by natural development. The cost of fertilizing the water was found to be less than a dollar an acre.

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HOW TO STOP BRAKE CHATTER

(Continued from page 56)

little uneven, a greasy brake facing may slip and catch again and start a vibration. Of course the usual effect of grease in a brake is just to make it not hold at all."

"That may be so", Miss Simpkins admitted. "In fact, I can see how it would work like that under certain conditions if grease got in the brakes, but there isn't a speck of grease on these brakes. *Anybody* can see that."

"So that can't be the trouble in this case," Gus smiled. "But if you look closely, you can see something is wrong. Can you spot it?"

THE science teacher adjusted her spectacles and peered closely at first one brake facing and then the other. "The only thing I notice, is that one is a lot shinier than the other. Is that what you mean?"

"Yes, that's it," replied Gus. "When a brake facing gets that particular kind of a shine on it, we call it glazed, and it doesn't hold nearly as well."

"I can understand that," said Miss Simpkins, interestedly. "Science teaches that friction depends on the kind of surface as well as on the pressure, and a shiny surface should slip more easily than a rough one. But how did that make the brakes chatter, and what causes the glazing?"

"I'm pretty sure it had nothing to do with the chatter in this case," Gus replied. "As to what causes brake linings to glaze, it's one of those troubles nobody is any too sure about. They do it now and then for no reason that you can see.

"One thing is sure," Gus continued, as he remounted the wheel, "and that is, when you have adjusted all the brakes so that they're as tight as you can get 'em but still are free when there is no pressure on the brake pedal, and yet one brake doesn't hold when you put on the brakes, take a look at the brake lining. It's almost sure to be either grease or glazing —unless, of course, the lining is worn out."

"Why couldn't there be something the matter with the levers that work the brakes?" the teacher asked, her grouch forgotten in the search for more knowledge.

"Suppose they're hydraulic brakes?" Gus countered. "You know that fluid pressure must be the same in all connected parts of the system unless something has actually jammed in one of the brakes—and that's mighty unlikely."

"But this car hasn't hydraulic brakes," Miss Simpkins objected. "Surely, with all those levers, one might get out of adjustment and pull harder on one brake than on another, mightn't it?"

"The equalizers prevent that," said Gus, looking up from the front of the car, where he was tightening some bolts. "When you push down the brake pedal, the force is applied to the middle of a bar, and the brakes are hooked to the ends so the pull on all the brakes is bound to be the same. So, no matter whether it's hydraulic or mechanical brakes, if one wheel doesn't do any work when you stop, always look first for the trouble in the brake itself. As a matter of fact, you hardly ever get brakes so they're exactly the same on both sides of the car no matter how even the pressure may be. There's sure to be little differences in the surfaces of the brake linings or the drums."

"WOULDN'T it be possible to fix things so you could adjust the relative pull applied to each brake to suit its own peculiarities?" Miss Simpkins suggested.

"Gosh!" Gus laughed as he shifted his wrench to the other hand. "That would be a sure-enough headache for the brake-service man. Besides, there'd be no use in doing anything like that. As brakes wear, they keep changing. One day, they'll be perfect. A few days later, say, after a long trip, you'll find that one rear brake is a bit stronger than the other. In a week or so, you may find that the strong brake has shifted to the other side for no reason at all."

"What are you going to do about that glazing—put in new material?" Miss Simpkins asked, as Gus finished with the other wheel and fished a hack saw out of the tool kit.

"No, I'll just roughen it like this," explained Gus, scraping the fine teeth of the hack-saw blade back and forth across the face of the brake, and gradually working around until he had removed all the shiny glaze.

"Won't it become glazed again very shortly?" Miss Simpkins asked, dubiously.

"It won't happen to this brake any quicker than to the others, now that I've got it in shape," Gus replied, as he tossed the hack saw back in the kit and started to remount the wheel.

"BUT what about that awful chattering? Can't you do anything to get rid of it?"

"Oh, that! Sure, it's fixed already. Didn't you see me tighten up the bolts that hold the front axle to the springs?"

"But what does the axle have to do with it?" the teacher asked in astonishment, peering curiously at the bolts he had mentioned.

"A whole lot, in this case," Gus grinned. "Whenever you get chattering or vibration in any piece of machinery, there's three things to look for. The first is motion—and there's plenty of that in an automobile. The second is friction or strain, and that's where brakes shine. The third is looseness that'll give the friction and motion a chance to turn into vibration. Those loose axle bolts were right where the strain of the brake and the motion of the wheel could get together and make the whole works jitter back and forth to beat the band."

Gus finished assembling the wheel and Miss Simpkins climbed into the car to test the brakes again.

"As a science teacher, I should have known it was something like that," she muttered to herself, as she vigorously jammed down the pedal. The chattering was gone.

AIRSHIP TAKES OFF ON WHEELS LIKE A PLANE

TAXIING across a grass-covered field at more than sixty miles an hour, on wheels fitted beneath its gondola, the U. S. Army airship TC-13 recently soared aloft in a successful test of a spectacular new take-off method for dirigibles. Lighter-than-air craft usually rise by virtue of their buoyancy alone, but the running start employed in the new method gives an additional boost, as when an airplane leaves the ground, and permits a much heavier load to be lifted. Experts who watched the recent test at Langley Field, Va., calculated that the 365,000-cubic-foot airship would thus be able to carry 580 extra gallons of fuel, thereby increasing its cruising range by 1,300 miles.

PLOWING THOUGH AIR HINDERS ROCKET TRAVEL

BALLS of air, piling up in front of rockets like snow in front of a man's foot, form an obstacle to high-speed travel in such projectiles, experiments conducted by the American Rocket Society have shown. When a test rocket had reached an estimated speed of 700 miles an hour, it wavered like a speedboat out of control and crashed into the ocean near its New York testing ground.